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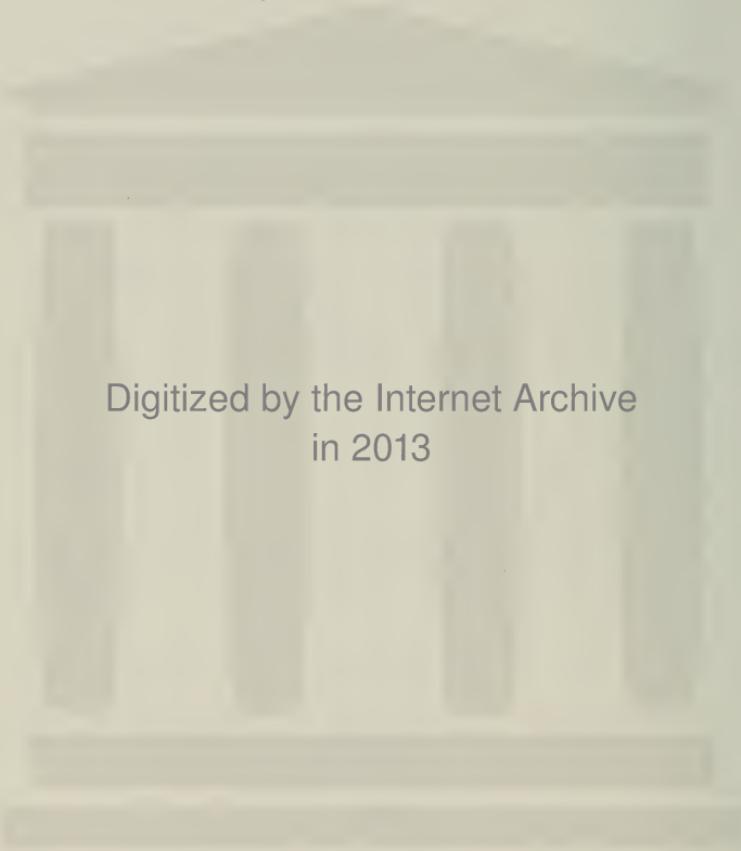# CHICAGO CIRCLE BULLETIN

GRADUATE STUDY 1973-1974

UNIVERSITY OF ILLINOIS AT CHICAGO CIRCLE

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Graduate Study

The University of Illinois

at

Chicago Circle

1973-1974

This publication is a record of the 1972-1973 academic year and an announcement of the 1973-1974 academic year.

Contents

Calendar of the Graduate College

1973-1974

Fall Quarter, 1973

September 17-21 (Monday-Friday)	Registration week
September 24 (Monday)	Instruction begins
September 28 (Friday)	Last day to submit titles of Ph.D. theses
October 22 (Monday)	Veterans Day (no classes)
October 26 (Friday)	Last day for Graduate College approval of format of fall quarter Ph.D. theses
November 2 (Friday)	Last day to drop a course
	Last day to submit titles of master's theses
November 16 (Friday)	Last day for Graduate College approval of format of fall quarter master's theses
	Last day for addition of names to the fall quarter graduation list
November 22, 23 (Thursday, Friday)	Thanksgiving vacation
November 30 (Friday)	Instruction ends
December 3-7 (Monday-Friday)	Final examinations

Winter Quarter, 1974

December 10-14 (Monday-Friday)	Registration week
January 2 (Wednesday)	Instruction begins
January 4 (Friday)	Last day to submit titles of Ph.D. theses
January 25 (Friday)	Last day to submit titles of master's theses
February 1 (Friday)	Last day for Graduate College approval of format of winter quarter Ph.D. theses
February 8 (Friday)	Last day to drop a course
February 15 (Friday)	Last day for Graduate College approval of format of winter quarter master's theses
February 18 (Monday)	Presidents Day (no classes)
February 22 (Friday)	Last day for addition of names to winter quarter graduation list
March 8 (Friday)	Instruction ends
March 11-15 (Monday-Friday)	Final examinations

Spring Quarter, 1974

March 18-22 (Monday-Friday)	Registration week
March 25 (Monday)	Instruction begins
March 29 (Friday)	Last day to submit titles of Ph.D. theses
April 5 (Friday)	Last day for addition of names to the spring quarter graduation list
April 12 (Friday)	Good Friday (no classes)

April 19 (Friday)	Last day to submit titles of master's theses
April 26 (Friday)	Last day for Graduate College approval of format of spring quarter Ph.D. theses
May 3 (Friday)	Last day to drop a course
May 10 (Friday)	Last day for Graduate College approval of format of spring quarter master's theses
May 27 (Monday)	Memorial Day (no classes)
May 31 (Friday)	Instruction ends
June 3-7 (Monday-Friday)	Final examinations
June 16 (Sunday)	Commencement

Summer Quarter, 1974

June 10-14 (Monday-Friday)	Registration week
June 17 (Monday)	Instruction begins
June 21 (Friday)	Last day to submit titles of Ph.D. theses
July 4 (Thursday)	Independence Day (no classes)
July 12 (Friday)	Last day to submit titles of master's theses
July 19 (Friday)	Last day for Graduate College approval of format of summer quarter Ph.D. theses
July 26 (Friday)	Last day to drop a course
	Last day for Graduate College approval of summer quarter master's theses
August 5 (Monday)	Last day for addition of names to the summer quarter graduation list
August 23 (Friday)	Instruction ends
August 26-30 (Monday-Friday)	Final examinations

1974-1975

Fall Quarter, 1974

September 16-20 (Monday-Friday)	Registration week
September 23 (Monday)	Instruction begins
September 27 (Friday)	Last day to submit titles of Ph.D. theses
October 21 (Monday)	Veterans Day (no classes)
October 25 (Friday)	Last day for Graduate College approval of format of fall quarter Ph.D. theses
November 1 (Friday)	Last day to drop a course
	Last day to submit titles of master's theses
November 15 (Friday)	Last day for Graduate College approval of format of fall quarter master's theses
	Last day for addition of names to the fall quarter graduation list
November 27 (Wednesday)	Instruction ends
November 28, 29 (Thursday, Friday)	Thanksgiving vacation
December 2-6 (Monday-Friday)	Final examinations

Winter Quarter, 1975

December 9-13 (Monday-Friday)	Registration week
January 2 (Thursday)	Instruction begins
January 3 (Friday)	Last day to submit titles of Ph.D. theses
January 24 (Friday)	Last day to submit titles of master's theses
January 31 (Friday)	Last day for Graduate College approval of format of winter quarter Ph.D. theses
February 7 (Friday)	Last day to drop a course
February 14 (Friday)	Last day for Graduate College approval of format of winter quarter master's theses
February 17 (Monday)	Presidents Day (no classes)
February 21 (Friday)	Last day for addition of names to winter quarter graduation list
March 7 (Friday)	Instruction ends
March 10-14 (Monday-Friday)	Final examinations

Spring Quarter, 1975

March 17-21 (Monday-Friday)	Registration week
March 24 (Monday)	Instruction begins
March 27 (Thursday)	Last day to submit titles of Ph.D. theses
March 28 (Friday)	Good Friday (no classes)
April 4 (Friday)	Last day for addition of names to the spring quarter graduation list
April 18 (Friday)	Last day to submit titles of master's theses
April 25 (Friday)	Last day for Graduate College approval of format of spring quarter Ph.D. theses
May 2 (Friday)	Last day to drop a course
May 9 (Friday)	Last day for Graduate College approval of format of spring quarter master's theses

May 26 (Monday)	Memorial Day (no classes)
May 30 (Friday)	Instruction ends
June 2-6 (Monday-Friday)	Final examinations
June 15 (Sunday)	Commencement

Summer Quarter, 1975

June 9-13 (Monday-Friday)	Registration week
June 16 (Monday)	Instruction begins
June 20 (Friday)	Last day to submit titles of Ph.D. theses
July 4 (Friday)	Independence Day (no classes)
July 11 (Friday)	Last day to submit titles of master's theses
July 18 (Friday)	Last day for Graduate College approval of format of summer quarter Ph.D. theses
July 25 (Friday)	Last day to drop a course
	Last day for Graduate College approval of format of summer quarter master's theses
August 4 (Monday)	Last day for addition of names to the summer quarter graduation list
August 22 (Friday)	Instruction ends
August 25-29 (Monday-Friday)	Final examinations

Administrative Officers

President . . . . John E. Corbally, Jr.
Chancellor . . . . Warren B. Cheston
Vice Chancellor . . . . Eugene Eidenberg
Vice Chancellor for Academic Affairs . . . . Arnold B. Grobman
Associate Vice Chancellor for
    Academic Affairs . . . . .Robert L. Hess
Associate Vice Chancellor for
    Academic Affairs .Joseph I. Lipson
Vice Chancellor for Operations . . . . Robert P. Bentz
Associate Chancellor . . . . .Nan E. McGehee
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Dean, College of Business Administration . . . . . . .Irvin L. Heckmann
Dean, College of Education . . . . .Van Cleve Morris
Dean, College of Engineering . . . . George Bugliarello
Dean, Graduate College .Jan Rocek
Dean, College of Liberal Arts and Sciences . . . .
Dean, College of Urban Sciences . . . . .Charles J. Orlebeke
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Associate Director, Jane Addams
    School of Social Work . . . . George W. Magner
Librarian . . . . William B. Ernst, Jr.
Director, Admissions and Records . . . . William C. Price

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Dean, Graduate College . . . . .Arnold Wolf

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Vice Chancellor for Campus Affairs,
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Director of Admissions and Records . . . . .Jane Loeb
Dean (Acting), Graduate College . . . . .George Russell

Graduate Units At Chicago Circle

Anthropology: M.A.
Robert L. Hall, Chairman
3102 Behavioral Sciences Building

Bioengineering: M.S., Ph.D.
Irving F. Miller, Head
1027 Science and Engineering Offices

Biological Sciences: M.S., Ph.D.*
Elmer B. Hadley, Head
3236 Science and Engineering South

Chemistry: M.S., D.A., Ph.D.
Specializations in organic, inorganic, and
physical chemistry.
William F. Sager, Head
408 Science and Engineering South

Criminal Justice: M.A., M.S.
Specializations in criminal justice (M.A.)
and criminalistics (M.S.).
James W. Osterburg, Head
4014 Behavioral Sciences Building

Economics: M.A.
Specializations in urban and quantitative
economics.
George Rosen, Head
2401 University Hall

Energy Engineering: M.S., Ph.D.
Specializations in continuum and
molecular fluid mechanics, heat and mass
transfer, and macroscopic and microscopic
thermodynamics.
James P. Hartnett, Head
912 Science and Engineering Offices

English: M.A.
Specialization in literature or creative
writing.
Jay A. Levine, Head
2333 University Hall

Geography: M.A.*
Specializations in urban geography,
regional development, and environmental
studies.
Clifford E. Tiedemann, Head
2102 Behavioral Sciences Building

Geological Sciences: M.S.
Specializations in crystallography,
mineralogy, petrology, and geochemistry;
paleontology, oceanography, sedimentology,
and sedimentary geochemistry.
Werner H. Baur, Head
2460 Science and Engineering South

German: M.A., Ph.D.*
Specializations in German literature;
German philology and linguistics.
Robert R. Heitner, Head
1605 University Hall

History: M.A., Ph.D.
Ph.D. specializations in early Europe and
modern Europe, and British, Russian,
French, Italian, and American history.
M.A. specializations in ancient world,
medieval Europe, Russia, Great Britain,
America (United States), Africa, imperi-
alism and colonialism, and historiography.
Ronald P. Legon, Chairman
727 Science and Engineering Offices

Information Engineering: M.S., Ph.D.*
Bruce H. McCormick, Head
1112 Science and Engineering Offices

Linguistics: M.A.
Andrew Schiller, Director
2311 University Hall

Materials Engineering: M.S., Ph.D.
Specializations in metallurgy, soil me-

chanics and foundations, structures (including concrete technology), engineering mechanics.
Ernest F. Masur, Head
816 Science and Engineering Offices

Mathematics: M.A., M.S., M.S. in Teaching of Mathematics, D.A., Ph.D.
Joseph Landin, Head
322 Science and Engineering Offices

Philosophy: M.A., Ph.D.
Myles Brand, Chairman
1803 University Hall

Physics: M.S., Ph.D.
Specializations in atomic and molecular physics, high energy physics, nuclear physics, solid state physics, theoretical physics.
Swaminatha Sundaram, Head
2244 Science and Engineering South

Political Science: M.A.
Specializations in American government, public administration.
David C. Leege, Head
1102 Behavioral Sciences Building

Psychology: M.A., Ph.D.
Leonard D. Eron, Chairman
1008A Behavioral Sciences Building

Social Work: M.S.W., D.S.W.
There is also a joint program with Mc-Cormick Theological Seminary. For details, write directly to the School of Social Work.
George W. Magner, Associate Director
4503 Education and Communications Building

Sociology: M.A., Ph.D.
Specializations in urban institutions and social psychology.
David B. Carpenter, Head
4118 Behavioral Sciences Building

Spanish: M.A.*
Specializations in applied linguistics and teaching, Latin American studies and peninsular studies.
Brian Dutton, Head
1733 University Hall

Speech and Theater: M.A.
Specializations in communication and public address and theater.
R. Victor Harnack, Head
1024 Education and Communications Buildi̇

Urban Planning and Policy: M.A.
Specializations in urban policy, community development, health planning, and educational planning.
Andrew Bavas, Coordinator
1140 Behavioral Sciences Building

*Intercampus degree program offered in cooperation with the Urbana-Champaign campus of the University of Illinois. See page 18.

Graduate College
1523 University Hall
University of Illinois at Chicago Circle
Box 4348, Chicago, Illinois 60680

Graduate *courses* are offered in some departments that do not yet offer a degree program; they are available to all graduate students as electives.

For additional information about programs listed in this catalog, correspond directly with the appropriate department at the listed address.

Executive Committee of the Graduate College

Jan Rocek, Ph.D., Dean of the Graduate College, Professor
    of Chemistry
Felix Candela, M.A., Professor of Architecture
Brian Dutton, Ph.D., Professor of Spanish
Philip Dwinger, Ph.D., Professor of Mathematics
R. Victor Harnack, Ph.D., Professor of Speech and Theater
Richard Kosobud, Ph.D., Professor of Economics
Audrey Kouvel, Ph.D., Professor of Spanish
Nicholas Moravcevich, Ph.D., Professor of Comparative Literature
William O'Neill, Ph.D., Associate Professor of Systems Engineering
Antonio Pagnementa, Ph.D., Professor of Physics
Charles Reed, Ph.D., Professor of Anthropology
Sheldon Rosenberg, Ph.D., Professor of Psychology
Harriet Talmage, Ph.D., Associate Professor of Education
Piergiorgio Uslenghi, Ph.D., Associate Professor of Information
    Engineering
Sidney Zimbalist, D.S.W., Professor of Social Work

Campus History and Information

On February 22, 1965, the University of Illinois at Chicago Circle opened its doors at its permanent location, which takes its name from the nearby transportation interchange symbolic of the flow of people within the urban region.

The move from Navy Pier, site of the University's Chicago Undergraduate Division for nineteen years, signaled the emergence of the principal public university at the service of—and in the midst of—the state's major population center.

Just as the physical growth of the University of Illinois at Chicago Circle was designed to answer the emphatically stated educational needs of the area's citizens, so have the instruction, research, and public service programs been organized and are regularly reviewed and improved to meet these expressed needs.

One of the historic qualities of the University of Illinois is its ability to integrate the research and public service activities of its faculty, staff, and student body with its educational programs. In the setting of Chicago Circle this capability points to professional fields and disciplines that have high impact upon urban life while maintaining a commitment to a wide range of programs fundamental to the development of special inquiry.

The first thirteen graduate programs were established in September, 1967. At the beginning of the 1973-1974 academic year the University of Illinois at Chicago Circle offers master's degrees in twenty-five fields and doctor's degrees in fourteen.

Other University of Illinois facilities in Chicago are at the Medical Center, which houses the Colleges of Medicine (including the School of Associated Medical Sciences), Dentistry, Nursing, and Pharmacy and the Health Sciences Division of the Graduate College.

Location, Mailing Address, and Transportation

The Chicago Circle campus is located just south and west of the Loop in an area bounded by the Eisenhower and Ryan Expressways, Racine Avenue, and Roosevelt Road. The mailing address is Box 4348, Chicago, Illinois

60680. Transportation to the campus is by way of the CTA, which has built a station at Peoria Street especially to serve Chicago Circle, and by the buses on Halsted, Harrison, and Taylor Streets and on Roosevelt Road.

Admission

The academic year at Chicago Circle consists of three 11-week quarters (including the final examination periods) that begin in September (fall quarter), January (winter quarter), and March (spring quarter). The 11-week summer quarter begins in June. A student may seek admission to any one of the four quarters; however, the scheduling in many departments makes it desirable that students enter in the fall quarter.

The minimum requirements for admission to the Graduate College are:

1. A baccalaureate from an accredited institution.
2. Recommendation for admission by the department to which application is made and by the Dean of the Graduate College.
3. A cumulative grade-point average of 3.5 (A=5.0), which is computed on the last 90 quarter hours (60 semester hours) of undergraduate work. Should the ninetieth hour fall in midterm, all credit completed in that term is included in the computation of the grade-point average.

   An applicant for post-master's work and a doctoral candidate who has earned a master's degree or has completed at least 48 quarter hours (32 semester hours) of graduate study at an accredited institution are also considered for admission on the cumulative grade-point average for the graduate work completed.

Some departments have adopted requirements higher than the minimum. For specific department requirements for the average required, the completion of the Graduate Record Examination, required undergraduate subjects, and additional information, consult the appropriate section of this catalog.

Unassigned Students. The Graduate College accepts a limited number of unassigned students who are not pursuing a degree but are endeavoring to fulfill a specific educational aim. For details see *Admission Status*.

Application Procedures

Applications for admission may be obtained from the Office of Admissions and Records, the departments, or the Graduate College Office. A

prospective student should apply for admission at least two months before the beginning of the quarter in which he wishes to enroll. The number of graduate students who can be admitted is limited and applications are processed in the order in which they are received. Admission consideration will cease when capacities are reached; therefore, it is in the best interest of the applicant to submit his application and supporting credentials as early as possible.

All applications must be accompanied by the nonrefundable application fee of $20. Applications will be reviewed only when all official transcripts and other required credentials have been received by the Office of Admissions and Records and forwarded to the appropriate department.

Foreign Applicants

Persons who have completed their studies outside the United States must present all post-secondary school credentials. Such credentials must include a record of all studies completed to date, grades or examination results received (including failing as well as passing grades), maximum and minimum grades obtainable in the school, rank in class, degrees, diplomas, and certificates earned, and length of the school year. *Documents must be authentic or certified, and those not written in English must be accompanied by certified English translations.*

Applicants whose native language is not English will be required to take the Test of English as a Foreign Language (administered by the Educational Testing Service, Box 899, Princeton, New Jersey 08540). If, for valid reasons, TOEFL scores cannot be obtained, another nationally recognized test of English proficiency may be substituted. In cases of clearly demonstrated knowledge of the English language, the test may be waived. Several English language courses for foreign students, designed to increase English competency, are available at Chicago Circle, and foreign students are urged to enroll in them.

All foreign applicants who plan to finance their study at the University of Illinois from personal resources must certify that they will have sufficient funds to cover their expenses. Obtain the appropriate form from the Office of Admissions and Records.

Foreign students granted admission will receive from the Office of Admissions and Records all appropriate documents, including the certification forms that are used in applying for visas to enter the United States.

Readmission Applicants

A student who did not complete in the Graduate College the quarter immediately preceding the one in which he wishes to enroll, *and* who had not

received approval for Off-Quarter Vacation or Leave of Absence, must submit an application for readmission. This rule does not apply to a student registering for the fall quarter if he was registered during the spring quarter. Such applications should be submitted no later than two weeks before the beginning of the quarter to which readmission is sought and must be accompanied by the $20 nonrefundable application fee.

Admission Status

Each new or readmitted student is issued one of the following types of Permits to Enter:

A. Regular
B. Limited—This is a probationary status for students who:

    1. Have less than a 3.5 entering grade-point average;
    2. Have departmental deficiencies to be removed;
    3. Present foreign credentials which must be evaluated at the time of registration; or
    4. Are within 8 quarter hours of their baccalaureate. (See page 20.)

    Permits for status B1, B2, or B3 are issued with the understanding that the major department will determine deficiencies or prerequisites and will advise the student on his program of study.

    A student may be admitted on limited status for a maximum of four quarters in residence or 24 quarter hours, whichever occurs earlier. The department shall specify the conditions for admission to full status in writing to the student and the Graduate College, preferably at the time of admission but not later than the end of the first quarter in residence. If the conditions are not met within the foregoing limits, the Graduate College will initiate drop action.

C. Unassigned (nondegree)

    Nondegree status may be granted in the following circumstances:
    1. The student participates in an intercampus program and is or will become a degree candidate on another campus of the University of Illinois (see *Intercampus Graduate Programs*).
    2. The student participates in a special nondegree program offered by a department or other unit.
    3. The student does not wish to pursue a degree program or a departmental nondegree program but intends to continue his

education in one or several fields. Applications for admission under this option must be accompanied by a letter outlining the student's plan of study and explaining why admission is sought on nondegree status. A member of the Graduate College staff will serve as adviser to the student in this category.

Nondegree status is not a probationary status and may not be used instead of "limited status." In admitting unassigned students, neither the Graduate College nor any unit at Chicago Circle makes a commitment toward admission to a degree program.

Should the unassigned student later be admitted to a degree program, credits earned while on nondegree status will ordinarily not be transferred. However, petitions for such transfer will be considered on an individual basis, after departmental approval.

Intercampus Graduate Programs

Several departments have developed intercampus programs by which Chicago Circle students can participate in degree programs offered by departments or units at the Urbana-Champaign or the Medical Center campus of the University of Illinois. Students will be able to fulfill degree requirements by taking courses at the Chicago Circle campus; they will register at the degree-awarding campus for thesis research, meet the requirements of the cooperating departments, and have members from both campuses on their examining committees.

Academic and General Regulations

A student should familiarize himself with the academic requirements and regulations of the Graduate College and of the department in which he is working. He is responsible for complying with these regulations and for fulfilling all requirements for his particular degree. Every graduate student should have a Graduate College catalog and a department brochure, if issued; they are official statements of policy. The usual procedures and requirements of the Graduate College are indicated in this catalog.

Petitions

A student may petition the Dean of the Graduate College for exceptions to any of the following regulations, but he should do so only after consultation with his adviser and the department coordinator of graduate studies. Forms for such petitions may be secured from the Graduate College.

Work Completed Elsewhere

Unless the department specifies otherwise at the time of admission, a doctoral candidate who has received a master's degree from an accredited institution will receive 48 quarter hours of credit toward the minimal 144 quarter-hour requirement for the doctoral degree; a petition is not required. A student who has completed, in an accredited institution, graduate work for which a degree was not awarded may petition for credit toward an advanced degree. After consultation between the student and his adviser, the department shall submit to the Graduate College its recommendations, which should include the courses required for transfer, those allowed (including the number of quarter hours of credit recommended), those disallowed, and grades and certification from the registrar or the college dean of the applicable institution that the courses are graduate level and were not used toward fulfillment of the requirements for a degree. The number of credits that may be transferred is determined on an individual basis. The number of credit hours in a given course that may be transferred to the Graduate College is limited to the number initially given in the undergraduate course. Six quarter

hours are the equivalent of four semester hours (or at the Urbana campus, one semester unit of graduate credit).

Graduate Study by Seniors at the University of Illinois at Chicago Circle

With the approval of the concerned department, the college, and the Graduate College, a senior at the University of Illinois at Chicago Circle may be admitted to the Graduate College if he is within 8 quarter hours of his baccalaureate. He will be admitted on limited status for a maximum of four quarters, pending completion of the baccalaureate. Courses used to fulfill undergraduate degree requirements may not be applied toward a graduate degree.

Upon recommendation of the department, an undergraduate student may be given graduate credit for graduate courses taken in his senior year. However, these courses may *not* be applied toward the baccalaureate degree.

Advisers

Each graduate student must have an adviser in the department in which he is a degree candidate. The adviser assists in planning a program of graduate study that fits the needs of the student and satisfies department and Graduate College requirements. A new student should contact the graduate coordinator or the director of graduate studies in his major department to discuss the selection of an adviser.

Courses of Instruction

Courses open to graduate students are of two types. Those numbered from 300 to 399 are open to advanced undergraduate and graduate students. Those numbered 400 to 499 are generally open only to graduate students. Some 300-level courses are available for graduate credit in departments other than those offering advanced degrees. Students should consult their advisers about the possibility of using these courses as minors.

A number of courses carry variable credit. At the 300 level, additional work, such as special reports, papers, or projects, is required of a student who registers for the maximum credit allowed. At the 400 level, some research, reading, and independent study courses provide variable credit; the proportion of time devoted to a particular activity can thus be indicated on the student's record.

Prerequisites. Exceptions to prerequisites listed in course descriptions in this catalog may be granted only with the consent of the instructor and under special circumstances.

Program Changes: A student has the option of dropping a course until the end of the sixth week of the quarter. Thereafter a course may not be dropped. However, holders of fellowships, tuition-and-fee waivers, and student visas must maintain the required number of credit hours.

Grades

Letter Grades: Final grades for courses are recorded as A, B, C, D (lowest passing grade), and E (failure). For all master's and doctoral work a cumulative grade-point average of 4.0 (A=5.0) on all course work presented for graduate credit, exclusive of courses numbered 499, is mandatory.

W— Officially withdrawn from the course without penalty.

IN— Incomplete. An IN must be removed by the end of the student's second quarter in residence subsequent to that in which it was received, or if he is not in residence, by the end of the first calendar year subsequent to that in which the IN was received. An IN that is not removed by the deadline will be changed automatically to a grade of IN/E.

DF— Grade temporarily deferred. At the end of a continuing course sequence the deferred grade of DF for all quarters must be converted either to a specific letter grade or to an IN. Deferred grades should be used only for 499 (Thesis Research) courses, for other research, continuing seminar, or sequential courses, and for independent study.

S— Satisfactory and

U— Unsatisfactory. To be used only as the final grade in graduate thesis research courses, in graduate and undergraduate courses that carry zero credit hours, and in other courses that have been specifically approved.

P— Pass and

F— Fail. To be used only in courses taken under the pass-fail grading option. A graduate student may take courses on a pass-fail basis provided that:

1. The courses are not within the student's immediate area of specialization.
2. Such courses account for no more than one-sixth of the total number of course hours taken at the University of Illinois at Chicago Circle and counted toward a degree.
3. The student declares his intention to take a course on this basis at the time of registration.

Probation and Drop Rules

Minimal Criteria of the Graduate College: If during two successive quarters in residence the cumulative grade-point average is below 4.00, the student will be placed on probationary status. After three consecutive quarters in residence with a cumulative grade-point average below 4.00 the student will be ineligible for further registration unless an exception can be justified by the executive officer of the department. The Graduate College issues probation and termination notices.

Departmental Standards: Departments may require a higher level of performance and may apply additional criteria. If the Graduate Committee of a department judges that the performance of a student is not satisfactory, it will issue a written warning to the student; a copy will be sent to the Graduate College. If, after at least one quarter, a second review indicates continued unsatisfactory progress, the department will inform the student and the Graduate College in writing; the Graduate College will then officially issue a notice of termination.

Repetition of Courses

A student will not be allowed to repeat a course for credit unless the course is designated in the Timetable as "may be repeated for credit."

Course Loads

Graduate students who are not employed are generally advised to carry no more than 16 quarter hours of credit, although up to 20 hours of course credit are permissible in exceptional cases with consent of the graduate student coordinator. It is recommended that students who hold part time employment outside the University should register for reduced loads.

Fellowship holders: Fellowships are awarded to superior students; therefore, fellowship holders are required to carry a minimum of 16 quarter hours of credit.

Graduate College tuition-and-fee waiver holders: Students awarded special Graduate College tuition-and-fee waivers must carry a program of 12 quarter hours.

Minimum full-time study: For purposes of enrollment certification to the United States Department of Justice, Immigration and Naturalization Service, the Graduate College considers a student to be pursuing a minimum full-time program of study if he enrolls for: (1) 12 or more quarter hours of graduate credit, or (2) a program of both graduate and undergraduate courses

equivalent to 12 quarter hours of credit, or (3) 10 quarter hours of graduate study plus an appointment for not less than one-third time, or (4) 8 quarter hours of graduate study and an appointment as a teaching or research assistant for not less than one-half time. However, if a veteran is to be eligible for full veterans benefits, he must be registered for at least 12 quarter hours of credit each quarter.

Auditing Privileges

A graduate student regularly registered may be permitted to attend classes as an auditor (without credit) at the discretion of the instructor. Students who wish to have their audited courses recorded must pay the Course-Visitor Auditor Fee (see Tuition and Fees). Persons not registered at the University of Illinois are permitted to attend classes, other than laboratory courses, as auditors provided they pay the fee and file with the Office of Admissions and Records a permission form bearing the approval of the instructor and the Dean of the Graduate College. A student should not enter on his program card any courses he attends as an auditor.

Regulations Pertaining to Degrees

All Graduate Degrees

Grade-Point Average: For all master's and doctoral work a cumulative grade-point average of 4.00 on all course work presented for graduate credit, exclusive of courses numbered 499, is mandatory.

Foreign Language Requirement: The foreign language requirement is left to the individual department, subject to the approval of the Graduate College.

Areas of Specialization: Every student must select a major area of specialization within his program. The major area of specialization consists of courses closely related to each other, not all of which are necessarily offered by the major department.

A minor area of specialization consists of a group of course offerings that have a distinct relationship, though they may be offered in more than one department. If a student elects, or is required by departmental regulations to declare, a minor area outside his major department, the courses chosen must be approved by the departments or divisions concerned.

Note: The following general requirements for the individual degrees are the minimum standards of the Graduate College. Students should consult the detailed departmental listings for a full statement of special or more rigorous

requirements in a particular program. It is the student's responsibility to be aware of all these regulations and requirements and to satisfy them as early as possible.

The Master's Degree

Residence: 24 quarter hours of work, including not more than 12 hours in courses titled Independent Study and Thesis Research, must be taken within two calendar years.

These 24 quarter hours (which may include 499, Thesis Research) must be earned at the University of Illinois at Chicago Circle. Exceptions may be granted by the Graduate College upon recommendation of the department.

Credit hours:

At least:
48 quarter hours beyond the bachelor's degree
24 quarter hours in the major field, including 12 hours at the 400 level
16 quarter hours at the 400 level
No more than:
18 quarter hours in 499, Thesis Research, in a 48-quarter-hour program

Thesis: A student electing or required to write a master's thesis should file the title with the Graduate College at least six weeks prior to graduation. Thesis students must register for a minimum of 8 hours in 499, Thesis Research, but for no more than 18 hours. Credit in thesis research will be applied only after the thesis is accepted. Specific instructions on the format of the thesis are contained in the leaflet, "Instructions for Preparation of Theses," that is obtained from the Graduate College Office, 1523 University Hall.

Examinations: If an examination is required, its structure is determined by the department. If a master's thesis is presented the candidate shall defend it before a committee appointed by the Dean of the Graduate College on the recommendation of the department. This committee shall consist of at least three persons, one of whom must have permanent membership on the graduate faculty. One member of the committee may be from outside the department or from outside the University. The approval of the thesis by a majority of the committee is required.

Time Limitation: A candidate for a master's degree must complete all requirements within four calendar years after his initial registration in the

Graduate College. In special circumstances the student, after consultation with his adviser, may petition the Graduate College and his department for an extension of this time limit.

The Doctoral Degree

Residence: At least 12 quarter hours beyond the master's level or its equivalent must be taken at the University of Illinois at Chicago Circle in regularly scheduled courses (excluding 499, Thesis Research and Independent Study) within one calendar year. Three consecutive quarters of at least 8 quarter hours each (which may include 499, Thesis Research) must be taken at the University of Illinois at Chicago Circle.

Credit Hours: At least 144 quarter hours beyond the bachelor's degree must be obtained for the doctoral degree.

Thesis: The Doctor of Philosophy is primarily a research degree, and the candidate must demonstrate his capacity for independent research by the presentation of an original thesis on a topic within his major field of study. The subject of the thesis must be reported to the doctoral committee and to the Graduate College at the time of the preliminary examination (see below). The candidate must register each term, except summer quarters, until he receives his degree. After satisfying the minimum credit requirement (144 quarter hours of courses and thesis research beyond the bachelor's degree) the student maintains his status as a candidate by registering for a full load of credit hours in 499, Thesis Research, until his dissertation has been accepted. If this imposes financial hardship or if the student is not making any use of University facilities or staff time, he may request Graduate College permission to register for zero credit in 499.

Candidates engaged in thesis research may find it desirable or expedient to publish prior to the conferring of the degree certain findings that later will be incorporated in the dissertation. In this case, appropriate acknowledgement of the earlier publication should be included in the dissertation. The Graduate College encourages such publication, but the thesis in its entirety may not be published before all degree requirements have been completed. Specifications for the format of the thesis are given in the leaflet, "Instructions for Preparation of Theses," which may be obtained in the Graduate College Office. The candidate must submit to the Graduate College Office, no later than the date specified in the current calendar of the College, the original and first carbon copy (or two copies reproduced by an approved method) of his thesis and one typewritten copy of an abstract not exceeding 600 words. Each candidate who passes the final examination must pay a $20 microfilm fee. This provides for microfilming the complete thesis, with one copy deposited in the University of Illinois Library, and publication of the abstract in *Dissertation Abstracts.*

Examinations: The Graduate College appoints a committee for each required examination. The first, the preliminary, is an examination of the candidate's grasp of the field of his major and minor subjects. The second is an examination on the candidate's dissertation. The department may have additional requirements. The committee for the preliminary examination shall consist of at least five persons representing the major and minor areas. Members of the committee will be appointed by the Dean of the Graduate College on recommendation of the department. At least two of these members must have permanent membership on the Graduate Faculty. One member of the committee may be from outside the University.

The preliminary examination may be written, oral, or both at the discretion of the department. The timing is also at the discretion of the department. The committee shall report its recommendations to the Graduate College. Part of the report will be a summary of the votes of the committee members. The committee vote shall be pass, conditional (specified), or fail. A candidate may not be passed if he receives more than one vote of fail. When there is no unanimity, the Graduate College will act as arbitrator. The Dean, in consultation with the department head and the committee chairman, may allow the candidate to be given a second examination at a later date. The second committee may consist of the same examiners. No more than two preliminary examinations may be given.

The dissertation committee shall follow the foregoing regulations except that the minimum membership shall be four, of whom two must be permanent members of the Graduate Faculty. One member of the committee may be from outside the department or from outside the University. At least three votes of pass are required, and no more than one vote of fail is allowed.

Teaching: Except in special cases, teaching is required of each graduate student as part of his professional growth and training.

Time Limitations: Doctoral condidates must complete their degree requirements within six calendar years after initial registration in a doctoral program. In special circumstances the student, after consultation with his adviser, may petition the Graduate College and his department for an extension.

Off-Quarter Vacation

A student may elect to attend any three quarters in one calendar year. If he chooses to use a quarter *other than the summer* as his vacation or Off-Quarter, he must file an application for Off-Quarter Vacation with the Office of Admissions and Records before the first day of instruction of the quarter he wishes to use as Off-Quarter Vacation. Application blanks are available in that office. If the vacation quarter is other than the summer quarter, the student must attend the summer quarter of that calendar year if he wishes to retain his status as a continuing student.

The student approved for an Off-Quarter Vacation is entitled to the same privileges as continuing students, provided he follows correct procedures. If he wishes to advance enroll, he must present written notice to the Office of Admissions and Records *prior to* the time for mailing advance enrollment materials to continuing students. Advance enrollment materials are prepared and mailed during the sixth week of the quarter. He may make arrangements with the Insurance Office to continue his hospital-medical-surgical insurance during the Off-Quarter Vacation.

Leave of Absence

For valid reasons a graduate student affiliated with a department may petition for a leave of absence for a maximum period of four consecutive quarters, including summer. Justification must be exceptionally strong for students in their first quarter of residence. A request for leave must be submitted prior to the period of leave and approved by the Dean of the Graduate College. Petition forms are available in the Graduate College and department offices.

Approved petitions will be filed with the Office of Admissions and Records. A student who has been granted a leave of absence need not reapply for admission. If a student intends to return prior to or at the conclusion of his approved leave, he should advise the Office of Admissions and Records in writing at least one month in advance and state the quarter for which he will register, so that registration material may be prepared for his use during residual registration.

With the exception of those enrolled in an intercampus program, leaves of absence will not be granted to unassigned students.

Tuition, Fees, and Other Charges

All students are assessed tuition and fees, which are payable in full as part of registration. The amount of tuition and the service fee vary with the number of credit hours for which the student registers. Tuition (but not the service fee) also varies according to the resident or nonresident status of the student in the State of Illinois.

Tuition and Fees—Chicago Circle
(Subject to Change)

	Range I 12 quarter hours and above		Range II 5½ through 11½ quarter hours		Range III 0 through 5 quarter hours		Range IV 0 credit only Resident and Nonresident
	Resident	Nonresident	Resident	Nonresident	Resident	Nonresident	
Tuition	$165	$495	$113	$333	$ 62	$172	$ 31
Service Fee	32	32	24	24	14	14	7
Hospital-Medical- Surgical Insurance	10	10	10	10	10	10	10
Health Service Fee	5	5	5	5	5	5	5
Total	$212	$542	$152	$372	$ 91	$201	$ 53

Tuition and Fee Deferment Information

A portion or all of a student's tuition and fees may be deferred at the time of registration in accordance with the following guidelines.

Deferment for Personal Reasons. A personal fee deferment will be granted to any student who does not have a delinquent account with the University. The schedule below indicates the down payment required at registration.

	Range I 12 quarter hours and above		Range II 5½ through 11½ quarter hours		Range III 0 through 5 quarter hours	
	Resi-dent	Nonresi-dent	Resi-dent	Nonresi-dent	Resi-dent	Nonresi-dent
Tuition and Fees	$212	$542	$152	$372	$91	$201
Minimum Amount Payable at Registration (includes $2 service charge)	107	272	77	187	47	102
Balance Due 30 Days After Classes Begin	$107	$272	$ 77	$187	$46	$101

Students who hold tuition waivers may not obtain a personal deferment of their fees. Personal deferments are not available to students registering during late registration.

Illinois State Scholarship Recipients. Students who hold Illinois State Scholarship awards that are less than the total assessed tuition and fees must pay the difference at registration. This difference may be deferred only if written evidence of other University financial aid in an amount sufficient to cover the difference is presented at the time of registration.

Recipients of Other Financial Aid. Students who hold other financial aid awards (National Direct Student Loan, Educational Opportunity Grant, or private scholarship) may defer their tuition and fees in full if the total of their financial aid award exceeds their tuition and fee assessment. If the financial aid award does not cover the total assessment, the difference must be paid at registration. To obtain full or partial deferment, written evidence of the financial aid award must be presented at registration.

Residence Classification of an applicant is determined on the basis of information given on his application and on other credentials. Fees are assessed in accordance with this decision. If the student believes he has a legitimate cause for change of status, he may petition for a change on a form

provided by the Office of Admissions and Records. Petitions are considered *within thirty days* from the date designated in the official University Calendar as that upon which instruction begins for the academic period for which the fee is payable. However, if the nonresident tuition was not assessed on or prior to that date, the claim for refund may be filed *within thirty days* after the nonresident fee was assessed and the student was given notice of its assessment. Additional evidence to substantiate a request may be required. If the student expects to ask for a change of residence classification, it is advisable for him to request that the adjustment be made prior to the registration period.

In the event a student who claims he is a resident is dissatisified with an adverse ruling of the Director of Admissions and Records, he may obtain a review of such decision by the Legal Counsel of the University by filing a written request with the Director of Admissions and Records within twenty days after he has been notified of the ruling.

Further information concerning residency may be secured from the Office of Admissions and Records. A brochure titled *Regulations Governing Assessment of Resident or Nonresident Student Fees* is also available.

Exemptions and Assessments

A student may be exempted from one or more of the following charges if he qualifies under the stated conditions:

Tuition is waived for:
1. Holders of tuition-waiver scholarships.
2. All academic employees of the University or allied agencies on appointment for at least 25 percent but not more than 67 percent of full-time service.
3. All permanent nonacademic employees of the University or allied agencies on appointment for at least 25 percent of full time who register in University courses in Range II or III.
4. Holders of graduate tuition-and-fee waivers awarded by the Graduate College.
5. Holders of grants or contracts from outside sponsors which provide payments to cover the total costs of instruction.
6. Teachers and administrators who cooperate in the practice teaching program. (Exemption is allowed for each quarter of assignment within the same calendar year—September through August.)
7. Persons registered in noncredit seminars only.
8. University employees registered at the request of their departments in noncredit courses especially established to improve the work of the employee.
9. Emeriti.

The nonresident portion of tuition (if the enrollee is subject to payment of tuition) is waived for:

1. All staff members (academic, administrative, or permanent nonacademic) on appointment for at least 25 percent of full time with the University or allied agencies.
2. The faculties of state-supported institutions of higher education in Illinois.
3. The teaching staff in private and public elementary and secondary schools in Illinois.
4. The spouses and dependent children of those listed in items 1 and 2. (Dependent children are those who qualify as dependents for federal income tax purposes.)
5. Persons actively serving in one of the Armed Forces of the United States who are stationed and present in the State of Illinois in connection with that service.
6. The spouses and dependent children of those listed in item 5, as long as they remain stationed, present, and living in Illinois.
7. Members of families of foreign diplomats whose assignment requires residence within the State of Illinois.

For fee assessment purposes, a staff appointment must be for not less than three-fourths of the term. This is interpreted as a minimum of nine weeks in a quarter. Staff tuition-and-fee privileges do not apply to students employed on an hourly basis in either an academic or nonacademic capacity or to persons on leave without pay.

For fee assessment purposes, a permanent nonacademic employee is defined as a person who has been assigned to an established, permanent, and continous nonacademic position and who is employed for at least 25 percent of full time. University employees appointed to established civil service positions whose rate of pay is determined by negotiation, prevailing rates, or union affiliation are entitled to the same tuition-and-fee privileges accorded other staff members under the regulations.

A student who resigns his staff appointment, or whose appointment is cancelled before he has rendered service for at least three-fourths of the term, becomes subject to the full amount of the appropriate tuition and fees for that term unless he withdraws from his University classes at the same time the appointment becomes void, or unless he files clearance for graduation within one week after the appointment becomes void.

Fees

The Service Fee is applied toward the operating expense of Chicago Circle Center, the financing of the Center building, and the cost of the Student Activities Program.

The service fee is waived for:

1. All staff members of the University or allied agencies who are on appointment for at least 25 percent of full time.
2. Holders of graduate tuition-and-fee waivers awarded by the Graduate College.
3. Students registered *in absentia.*
4. Students registered in courses taught off campus.
5. Holders of grants or contracts from outside sponsors if the service fee is charged to the contract or to grant funds.
6. Cooperating teachers and administrators described under *Exemptions,* item 6.
7. Persons registered in noncredit seminars only.
8. University employees, registered at the request of their departments, in noncredit courses for the purposes of improving their work.
9. Emeriti.

The Course-Visitor-Auditor Fee of $15 is assessed all class visitors who are not in Range I in the tuition-and-fee schedule.

The Late-Registration Fine of $15 is levied against all students who complete registration after classes have begun.

The Hospital-Medical-Surgical Insurance Fee is the same for all students, regardless of the number of hours for which they have enrolled or of their Illinois residence status. All students enrolled and in attendance at Chicago Circle are covered by a health insurance policy, for which they pay a fee each quarter at registration. Eligible dependents of insured students (spouse and/or unmarried dependent children under nineteen years of age) may also be insured if the student makes application to the University Cashier (Room 406, University Hall) within the time specified by the insurance policy.

If a student withdraws from the University, he does not receive an insurance fee refund since he remains insured for the balance of the quarter from which he withdrew. Special provisions exist for students to be covered by this insurance during the summer months, irrespective of their registration for that part of the year. For further information, consult the Insurance Office, Room 427, University Hall.

If a student presents evidence of insurance in force which provides him equivalent coverage, he may petition the University Insurance Office for a refund of this fee. Refunds are not made on any other basis. The student should also consult the Insurance Office about the time limit for such a refund petition.

The Deferred-Fee Charge of $2 is assessed when arrangements have been made with the Office of Business Affairs to defer payment of fees. The charge must be paid on the day the agreement is reached and is nonrefundable. See *Tuition and Fee Deferment Information.*

The Lost Photo-Identification-Card Fee of $1 is assessed for replacing a lost or destroyed Photo-Identification Card, issued to the student at the time of his first registration at Chicago Circle. Cost for replacing the current Student Fee Receipt Card is 50 cents.

The Transcript Fee. A student is issued one transcript of his record without charge. For each additional transcript, a fee of $1 is assessed.

Refunds

Students who withdraw from the University or from a course within certain time periods are entitled to a refund of a portion of the tuition and fees they have paid.

Withdrawal from the University. The full amount of tuition and fees, *less a nonrefundable charge* of $31 for those enrolled for 12 or more hours and $30 for those enrolled for 11½ and fewer hours, is refunded to students who withdraw *within the first ten days of instruction* in a quarter. No refund is made if withdrawal occurs thereafter.

Withdrawal from a Course. If such withdrawal results in a reduction in the student's program to a lower tuition-and-fee range, the full difference is refundable during the *first ten days of instruction.* No refund is made if withdrawal occurs thereafter.

Withdrawal by a Visitor. A full refund will be issued if the withdrawal is made *within the first ten days of instruction.* No refund is made if withdrawal occurs thereafter.

The calendar in the quarterly Timetable indicates the date on which the regulations are effective.

Withdrawal to Enter Military Service: When a student withdraws to enter military service, he must be on active duty within ten days after withdrawal to receive a refund of tuition and fees. It is his responsibility to present proof of his active-duty status. The most effective way of presenting such proof is to have the personnel officer of the unit to which he is assigned certify to the University the date of the student's assignment to active duty.

Transcripts

Each student who has paid all his University fees is entitled to one transcript free of charge. (See *Transcript Fee.*) However, students who are in

debt to the University are not eligible for readmission and are not entitled to official transcripts and diplomas until the indebtedness is cleared.

Transcripts of official records are issued only on the request of the student. The Office of Admissions and Records will honor a student's written request to have information other than that which is considered public (such as name, date of attendance, curriculum, and degree and honors earned) released or withheld. The Director of Admissions and Records may, at his discretion, release academic information in order to obtain financial assistance or honors recognition for the student.

Assistantships, Fellowships, and Financial Aid

Various types of financial assistance are available each year to promising students in all fields of study in the Graduate College. Information in this section deals chiefly with aid administered by the University of Illinois. It should be noted, however, that there are also nationally sponsored fellowships that provide support for graduate students for study either at the University of Illinois or elsewhere, such as the National Science Foundation fellowships. Other fellowships are offered through foundations, industrial concerns, and individuals. Further information and application procedures for nationally sponsored fellowships may be obtained by writing directly to the agency concerned or to the University department in which the student plans to major.

The University of Illinois at Chicago Circle offers five basic types of financial aid for graduate students: fellowships, assistantships in teaching and research, tuition-and-fee waivers, loans, and employment. Each type of assistance is described in the following sections. In the operation of these programs and in selecting individuals for participation in and administration of the programs, the University of Illinois will not discriminate on the grounds of race, creed, color, sex, or national origin of any applicant or participant.

Fellowships

Fellowship stipends are gratuities awarded in recognition of scholarly achievement and promise. They enable a student to pursue his graduate studies and research without requiring him to render any service. The stipends of different fellowships vary, but with few exceptions they are currently not less than $1800 for the nine-month academic year. The fellow's stipend is legally regarded as a gift, not as compensation for services rendered. Funds for income tax are not withheld. Unless explicitly stated otherwise, all fellows whose appointments are administered by the Graduate College are exempt from tuition and fees. A fellow is required to pursue a full program of graduate study (at least 16 quarter hours per quarter) and may engage in remunerative employment only to the extent permitted by the award or approved in writing by the Dean of the Graduate College.

University Fellowships are awarded on the basis of an all-campus competition and are not restricted to any particular field of graduate study listed in this catalog. University fellowships are for nine months and carry a stipend of not less than $2,000 plus exemption from tuition and all regular fees except the Hospital-Medical-Surgical Insurance fee.

A student who receives a University fellowship is also eligible to accept a part-time assistantship related to his field of study up to a maximum of one-quarter time. Under such an appointment, the fellow's basic stipend remains unchanged and tax-free, but the salary for teaching or research is generally subject to income tax. University fellows, whether they hold a part-time assistantship or not, must carry full programs of graduate study (at least 16 quarter hours per quarter) unless expressly authorized by the Dean of the Graduate College to carry reduced programs. Students whose first interest is in teaching should so indicate on their applications.

Industrial, Endowed, and Special Fellowships. Various industrial firms, foundations, and private individuals have generously donated funds to support a number of special fellowships for graduate students at the University of Illinois. The stipends and supplemental allowances of these fellowships are not uniform, and most of them are restricted to students in particular areas of study. Further information may be obtained from the department in which the student plans to register.

Assistantships

The various departments of the University employ graduate students as either teaching assistants or research assistants. The duties of a teaching assistant usually involve such activities as classroom instruction, supervision of a laboratory section, the guidance of discussion sections, and paper grading. Research assistants participate in research activities under the supervision of University faculty members. In some instances the work of a research assistant may be related to his thesis research; in others it may be entirely different. Although most research assistantships are awarded to graduate students who have completed one or more quarters of graduate work at the University of Illinois, new students are eligible for such appointments. Each assistant is paid a salary for services rendered, and, under present ruling, this salary generally is subject to income tax.* The weekly clock hours of service required of assistants are 37½ for a full-time appointment and the proportional fraction of time for part-time appointments. Those whose appointments are for more than 25 percent time or more are exempt from tuition and all fees except the Hospital-Medical-Surgical Insurance fee.

*The District Director of Internal Revenue has ruled that under certain conditions income tax need not be withheld from remuneration paid to research assistants engaged in thesis research.

The usual course load for a full-time student is 16 quarter hours. A student holding a half-time assistantship or the equivalent in outside employment is advised to carry not more than 12 hours. The student should consult his department adviser if he wishes to enroll for a heavier load.

Graduate students who hold academic appointments for the winter and spring quarters of one academic year, either as employees or fellows, and for whom tuition and/or fees have been provided through waiver or through cash payment by an outside agency, are entitled to a waiver of the same kinds of tuition and fees for the summer quarter immediately following, provided they do not hold appointments during the summer quarter.

Tuition-and-Fee Waivers

A graduate tuition-and-fee waiver provides exemption from tuition and all incidental fees (except the Hospital-Medical-Surgical Insurance fee) for the academic year. To hold these awards students must be in residence and must register for at least 12 hours per quarter during the academic year. They may, however, accept part-time or incidental employment not to exceed 20 hours a week either within or without the University.

Veterans who are admissible to a graduate program and who meet certain residence requirements may be eligible for exemption from tuition and certain fees under the Illinois statute covering military scholarships. Further information may be obtained from the Office of Financial Aid, 1312 University Hall.

How to Apply

Application materials and instructions may be obtained from the Graduate College or from any graduate department. Only one application form is needed to apply for any of the types of financial aid listed.

To insure that an applicant will be considered for all fellowships and other financial assistance programs for the fall quarter beginning in September, the application should be filed with the major department no later than the preceding February 15. Applications for tuition-and-fee waivers and assistantships are accepted by the departments after that date, but applicants for such appointments are strongly urged to submit their applications as early as possible since many departments offer their assistantships at the same time they consider applications for fellowships.

Announcement of Awards

Most of the fellowship awards are announced by the Graduate College on or about April 1. Recipients are expected to accept or decline by April 15.

The University of Illinois adheres to the following resolution adopted by the members of the Association of American Universities and a number of other graduate schools in North America:

> In every case in which a graduate assistantship, scholarship, or fellowship for the next academic year is offered to an actual or a prospective graduate student, the student, if he indicates his acceptance before April 15, will still have complete freedom to reconsider his acceptance and to accept another fellowship or graduate assistantship. He has committed himself, however, not to resign an appointment after this date unless he is formally released from it.

Financial Aid

Graduate students should apply directly to the Graduate College for information related to fellowships, scholarships, tuition waivers, assistantships, and other forms of assistance specifically reserved for graduate students. *However,* graduate students interested in National Direct Student Loans, University Long-Term Loans, and employment through the College Work-Study Program should apply to the Office of Financial Aid. Veterans benefits are also processed by the Office of Financial Aid.

Loans

The Chicago Circle Office of Financial Aid administers and processes loan programs for which graduate students are eligible to apply. Students should apply directly to the Office of Financial Aid for information regarding any of the following loan programs.

National Direct Student Loans (NDSL)

1. The applicant must file a Chicago Circle Application for Financial Aid and submit the ACT Family Financial Statement. No other financial statement is acceptable.
2. An eligible graduate student may borrow up to $2,500 per year, to a total of $10,000, for his undergraduate and graduate years of study.
3. Funds are disbursed to the student quarterly.
4. Interest on the NDSL is set by federal law at 3 percent annually.
5. Repayment is to begin nine months after the student has ceased to be enrolled in at least a half-time course of study at any institution of higher education.
6. The entire loan must be repaid with interest within ten (10) years after repayment has begun, with minimum payments set at $30 per month.
7. Deferment of repayment is to be arranged with the University Bursar.

University Long-Term Loan (ULT)

1. The applicant must file a Chicago Circle Application for Financial Aid and submit the ACT Family Financial Statement. No other financial statement is acceptable.
2. An eligible graduate student may borrow up to $2,500 per year, to a total of $7,500, for his undergraduate and graduate years of study.
3. Funds are disbursed to the student quarterly.
4. Interest on the ULT is 3 percent annually.
5. A cosigner is required. The cosigner must be a United States citizen or legal permanent resident of the United States, must be age 21 or over, and must be fully employed. The Board of Trustees has ruled that the cosigner may not be an employee of the University of Illinois.
6. Repayment is to begin four months after the student has left the University.
7. The entire loan must be repaid within a period of seven years, with minimum payments set at $30 per month.
8. Deferment of repayment because of attendance at another institution of higher education is dependent upon annual verification and written agreement of the note cosigner.

Federally Insured Student Loans (FISL)

Graduate students who are *not* legal residents of Illinois should consult with their home state banks or FISL agencies. The requirements and provisions of FISL programs are essentially the same throughout the United States. The Illinois Guaranteed Loan Program, described below, is a review model for nonresidents.

Illinois Guaranteed Loan (IGL)

1. The student must be a resident of the State of Illinois, as defined in the program literature.
2. The student must file the IGL application with a participating Illinois bank, credit union, or other commercial lender.
3. The student has the *option* of submitting the ACT Family Financial Statement to the Chicago Circle Campus Office of Financial Aid:

   A. Students who submit the ACT Family Financial Statement will be considered for the federal interest subsidy if they qualify.
   B. Students who *do not* submit the ACT Family Financial Statement will *not* be considered for the federal interest subsidy. The lending institution will then have the option of providing a loan to the

student, and the student will be obligated to make periodic interest payments during the course of his study.

4. Funds are disbursed by the banks through the University on an *annual* basis.

5. Interest on an Illinois Guaranteed Loan is established by federal law as follows: for a student who qualifies for the federal interest subsidy, interest at 7 percent annually does not accrue until nine months after the student has ceased to pursue a full-time course of study. If a student does not qualify for a federal interest subsidy, interest at 7 percent annually begins to accrue with the use of the funds.

6. Repayment is to begin both for subsidized and unsubsidized loans nine months after the student ceases to pursue a full-time course of study.

7. The entire loan plus interest must be repaid within a period of six years after repayment has begun, with minimum payments graduated from as low as $30 to as much as $150 per month, depending on the size of the loan.

8. Deferments for attendance at other institutions and for other acceptable reasons are negotiated with the administrators of the Illinois Guaranteed Loan Program.

Short-Term Emergency Loans. Students may request short-term emergency loans from $5 to $100. These loans may be used for educationally related expenses other than tuition. The loan must be paid within forty-five days or by the end of the quarter, whichever date is earlier. Request forms may be obtained from the offices of the Dean of Men or the Dean of Women, Room 809, University Hall.

Employment

The Student Employment Office, 1301 University Hall, welcomes the opportunity to counsel students about employment. The office also offers students a library of job-reference materials, job listings, interviews, and referrals for employment to University departments and to agencies and business firms in the Chicago area. Securing a position through proper application and retaining that position through good work is, of course, the responsibility of the individual.

Campus Facilities and Student Services

The Library

Composed of the Main Library, the Science Library, and the Mathematics Library, the Library of the University of Illinois at Chicago Circle has a collection of more than 479,000 books and bound periodicals, 192,000 government documents, 72,000 maps, and an extensive and expanding collection of more than 232,000 microforms. The Library also receives more than 7,000 periodicals. Open stack shelving provides the student with direct access to books and other materials.

Interlibrary loan service with the Urbana-Champaign campus library and with the many excellent area libraries enhances the research facilities of the Chicago Circle Library.

The Computer Center

To fulfill the charge of administering a facility that meets the instructional and research needs of the University, the Computer Center has been equipped with an IBM 370 Model 155 computer with 1,048,576 bytes of core storage. In addition, it has an extensive conversational time-sharing system with typewriter and teletype terminals located throughout the campus. The Center also operates an IBM 1800 process control computer with 32,768 words of 2 microsecond core storage. Introduction at an early date of a virtual memory system is anticipated.

The staff of the Computer Center teach courses in programming, software design, theory of computation, and numerical analysis in cooperation with the Department of Mathematics and the College of Engineering. The staff also assists other departments in utilizing the equipment for both instruction and research.

Campus Laboratory Facilities

The Departments of Biological Sciences, Chemistry, Geological Sciences, and Physics and the engineering sciences occupy extensive research facilities

in the Science and Engineering Laboratories and in Science and Engineering South.

The Phonetic-Linguistic Research Laboratory contains recording and specialized equipment patterned after a similar installation at the University of Hamburg.

The Behavioral Science Center maintains research laboratories for studies in demography, sociology, and psychology.

Joint-Study and Research Facilities Within the City

The University of Illinois Medical Center departments cooperate with the Chicago Circle Departments of Biological Sciences, Chemistry, Psychology, and Sociology in encouraging joint graduate study, seminars, and the use of the Medical Library.

The Newberry Library (social sciences and humanities), the Crerar Library (science and technology), the Art Institute, the Field Museum of Natural History, the Museum of Negro History, the Library of International Relations, the Center for Research Libraries, the Chicago Historical Society, and the Chicago Municipal Reference Library are important nearby research facilities.

Student Services

The Dean of Student Affairs, a major officer of the University, coordinates the activities and functions that provide a wide range of services to Chicago Circle Students. The personnel of his office and the offices of the Dean of Men and Dean of Women (both of whom are also associate deans of student affairs), the Director of Veterans Affairs, the Office of Financial Aid, and the Student Counseling Service, the Placement Service, the Office of Foreign Student Affairs, the University Health Service, and the Office of Organizations and Activities are available to students who require the services these offices administer.

Housing Office

A wide range of housing services is offered to graduate students. Daily and weekly housing can be arranged for newly arrived graduate students while they are searching for permanent quarters. Special rates are available at motels convenient to the campus when reservations are made through this office. Daily and weekly rates are available.

Every effort is made to assist those wishing to share their accommodations and those seeking such an arrangement. The Housing Office

also cooperates with off-campus organizations specializing in locating roommates.

Brochures and listings of privately owned housing, including furnished and unfurnished apartments, houses for rent or for sale, and rooms for rent are available in this office. Persons listing housing accommodations have signed a pledge not to discriminate on the basis of race, religion, or national origin. Call or write:

Office of Auxiliary Services
Housing Office
Box 4348, Chicago, Illinois 60680
Telephone (312) 996-5055 or 5058

Circle Children's Center

The Center is available for day care of the children of the University community. Full-time care rates are based on family income, varying from $14 to $26 per week. Part-time care may be arranged. Call 996-8663 for specific information and application forms.

The Departments

Admission and degree requirements of the departments are in addition to those of the Graduate College. Students must familiarize themselves with *both* sets of requirements. Exceptions to prerequisites listed in course descriptions in this catalog may be granted only with the consent of the instructor and under special circumstances.

Anthropology

Robert L. Hall, Chairman of the Department

Professors: Pedro Armillas, Laura A. Bohannan, Charles A. Reed

Associate Professors: Susan T. Freeman, Merwyn S. Garbarino, Graduate Coordinator, Robert L. Hall, Paul Hockings, Jack H. Prost, Sylvia J. Vatuk

Assistant Professors: Elizabeth A. Brandt, James L. Phillips, Stephen L. Schensul

The department offers a program leading to the Master of Arts.

Admission Requirements

An applicant must have a baccalaureate from an accredited college or university, must meet the requirements for admission to the Graduate College, must have a grade-point average of 4.00 (A=5.00) for the last 90 quarter hours of undergraduate study, and must rank above the 70th percentile on the Graduate Record Examination verbal and quantitative tests. Three letters of recommendation and a brief statement outlining the student's professional goals must be submitted. A student who enters without an adequate background in anthropology will be expected to make up deficiencies before formal admission to candidacy is granted.

Degree Requirements

A minimum of 48 quarter hours is required for the master's degree. All candidates must complete the course work outlined below, pass a comprehensive examination, and submit a thesis. Students engaged in specialized thesis research that demands a reading knowledge of a foreign language or a working knowledge of statistics will be expected to demonstrate satisfactory comprehension of the relevant language or skill. Foreign students must have adequate facility in the English language.

Students are encouraged to complete a minimum of 36 quarter hours of study before admission to the comprehensive examination for the M.A. in anthropology. The distribution of graduate courses is:

12 quarter hours in Anthropology 400, Theory and Method in Anthropology; 430, Theory and Method in Physical Anthropology; 450, Theory and Method in Prehistory.

16 quarter hours in advanced courses in anthropology or related fields, such as sociology, political science, psychology, or history.

A minimum of one seminar in the anthropological field of specialization.

No more than 16 hours in Anthropology 499, Thesis Research.

After three quarters of residence a candidate ordinarily is expected to pass a comprehensive examination covering the following fields of anthropology: physical anthropology; archaeology; and ethnology of one culture area, such as North America, Mesoamerica, Africa, or Europe.

Courses for Graduate and Advanced Undergraduate Students

310. PEASANT SOCIETIES. 4 HOURS. Research and reading in the comparative study of peasant societies in diverse regions of the world; special emphasis on a critical review of the anthropological literature delineating a peasant stratum of social organization and defining its characteristics. Prerequisites: Junior standing and 8 hours of social anthropology or 8 hours of sociology and consent of the instructor.

311. CULTURAL PROBLEMS IN URBANIZATION. 4 HOURS. The processes of urbanization and of cultural and societal adjustments to urban life; case studies illustrate the variety of adjustments to urban life. Prerequisite: Anth. 213.

314. KINSHIP, FAMILY, AND HOUSEHOLD. 4 HOURS. Comparative study of the institutions of marriage, family, and household; the extension of kinship norms and values to other aspects of culture and society. Prerequisite: Anth. 213.

315. COMPARATIVE RELIGIOUS MOVEMENTS. 4 HOURS. Same as Religious Studies 315. Analysis of religious behavior; special reference to the emergence of messianic cults in Africa and Melanesia and among North American Indians and New World Negroes. Prerequisites: Junior standing, 8 hours of social anthropology or 8 hours of sociology, and consent of the instructor.

316. ECONOMIC LIFE OF PRIMITIVE PEOPLES. 4 HOURS. Patterns of production, distribution, and consumption in non-Western cultures. Cultural variation in attitudes toward labor, concepts of property, and prestige and wealth. Prerequisite: 8 hours of social anthropology; for nonmajors, Junior standing and consent of the instructor.

317. THE CROSS-CULTURAL STUDY OF SOCIAL CONTROL. 4 HOURS. Cultural-jural structures in non-Western societies; modes of dispute settlement, nature and range of sanctions, and processes of social control. Prerequisite: Junior standing and Anth. 213 or 327.

320. PSYCHOANALYTIC ANTHROPOLOGY. 4 HOURS. For social scientists. Introduction to Freud's thought and theories on dreams, child development, character, neurosis, and other psychic phenomena; the cross-cultural application of Freud's theories. Anthropological influences in the development of psychoanalytic ego psychology. Prerequisite: Anth. 220 or graduate standing.

321. CULTURAL EVOLUTION. 4 HOURS. Critical review of theories; examination of ethnographic materials and data on cultural change and cultural contact for the purpose of examining the mechanisms of change. Prerequisite: Anth. 200.

322. COMPARATIVE METHODS IN SOCIAL ANTHROPOLOGY. 4 HOURS. Introduction to the several kinds of comparative methods, including field work, small-sample and large-sample studies. Prerequisite: Anth. 213.

325. MEDICAL ANTHROPOLOGY. 4 HOURS. Significance of anthropological analysis and the cross-cultural perspective for medical care. Medicine as a cultural adaptive system. Social organization, politics, and economics of medical care systems, folk and modern. Folk medicine. Cross-cultural perspectives on psychiatric care. Prerequisite: Anth. 200.

327. PRIMITIVE POLITICAL SYSTEMS. 4 HOURS. Examination of data and theory pertinent to non-Western political systems; a cross-cultural study of political behavior. Prerequisites: Junior standing and Anth. 213.

330. PRIMATE EVOLUTION. 4 HOURS. Same as Biological Sciences 330. Paleontology and systematics of fossil primates as illuminated by the anatomy, ecology, and behavior of the living populations. Prerequisite: Anth. 231 or BioS. 282 or 318.

331. HUMAN EVOLUTION. 4 HOURS. Same as Biological Sciences 331. The phylogeny of the primate order and the problems of speciation; particular emphasis on the relative roles of culture and nature as selective forces in human evolution. Prerequisite: Anth. 230 or 231, or BioS. 282 or 318.

350. PROBLEMS IN PREHISTORIC ARCHAEOLOGY. 4 TO 12 HOURS. May be repeated for credit up to a total of 12 hours. Archaeological field techniques and principles of the study of prehistory. Case studies from selected areas of the Old and New Worlds. Prerequisites: 12 hours of archaeology and consent of the instructor.

351. PREHISTORY OF THE NEAR EAST. 4 HOURS. Consideration of southwestern Asia and northeastern Africa as the core area in which the first civilizations emerged. Emphasis on the late Quaternary to about 5000 B.C.; the interrelationships between changing environment, human ecology, and cultural evolution. Prerequisite: Anth. 251 or consent of the instructor for qualified students from other departments.

352. EARLY CIVILIZATION OF THE OLD WORLD. 4 HOURS. Early civilization and incipient urbanization in Eurasia and Africa, with focus on the development of urban centers and archaic states; attention to preconditioning factors in the post-Pleistocene, Mesolithic, and Neolithic Ages. Prerequisite: Anth. 251 or 351.

355. FIELD PROBLEMS IN ARCHAEOLOGY. 6 TO 12 HOURS. Application of advanced techniques to the solution of special problems of archaeological field investigations; laboratory analysis under field conditions at an off-campus location. Prerequisites: Anth. 245 or 255 or concurrent registration in Anth. 255 and consent of the instructor.

361. PROBLEMS IN MESOAMERICAN ETHNOLOGY. 4 HOURS. Same as Latin American Studies 354. Intensive investigation of selected problems from the Mesoamerican area; special emphasis on religion, economics, and social organization. Prerequisite: Anth. 261.

362. PROBLEMS IN AFRICAN ETHNOLOGY. 4 HOURS. Survey of the indigenous cultures of Africa; native cultures as reconstructed coterminous with their early historical contacts with the Western world; some additional data on present-day African cultures. Prerequisites: Junior standing and Anth. 263.

363. URBAN CULTURES OF AFRICA. 4 HOURS. The indigenous urban centers of sub-Saharan Africa and the multicultural and multiracial metropolitan areas of colonial and contemporary Africa; special reference to the processes of segregation and detribalization. Prerequisite: Anth. 263 or 362.

364. PROBLEMS IN NORTH AMERICAN ETHNOLOGY. 4 HOURS. Intensive reading and research focusing on special problems of religious, economic, and social systems of New World native peoples. Prerequisite: Anth. 264.

365. PROBLEMS IN PACIFIC ETHNOLOGY. 4 HOURS. Ethnological survey of the indigenous peoples of Micronesia, Polynesia, Melanesia, and Australia; special emphasis on the social, economic, and religious life of representative groups. Prerequisites: Junior standing and 8 hours of social anthropology.

366. PROBLEMS IN SOUTH ASIAN ETHNOLOGY. 4 HOURS. Theoretical and substantive problems in the study of South Asian social organization; special emphasis on systems of social stratification, kinship and family structure, religion, economy, and political processes in the context of social change. Prerequisites: Junior standing, Anth. 213 and 266.

367. PROBLEMS IN SOUTH AMERICAN ETHNOLOGY. 4 HOURS. Same as Latin American Studies 367. Intensive reading and research in theoretical and

ethnographic problems in South American Indian social structures and cultures. Special attention is given to the influence of Levi-Strauss' ideas on the formulation of cultural theory in South America. Prerequisite: Graduate standing or Anth. 213 and 265.

368. PROBLEMS IN EUROPEAN ETHNOLOGY. 4 HOURS. Advanced reading and research in the ethnology of rural Europe; study in depth of selected case materials. Emphasis on community structure, kinship, religious and economic systems, and methods of social control; research techniques and the nature of source materials. Prerequisite: Anth. 213.

380. PROBLEMS IN LINGUISTIC ANALYSIS. 4 HOURS. Same as Linguistics 380. Examination of the methods and techniques used in linguistics, with reference to actual language data; emphasis on anthropological applications. Prerequisite: Anth. 280 or Ling. 305.

395. SEMINAR ON ANTHROPOLOGY. 2 TO 4 HOURS. May be repeated for a total of 16 hours of credit. Reading, study, and discussion of selected problems. For graduate students and majors in anthropology; open, with the approval of the department, to seniors minoring in anthropology. Prerequisite: Consent of the instructor.

399. INDEPENDENT STUDY. 2 TO 12 HOURS. May be repeated for credit. Independent study under the supervision of a staff member. Prerequisites: Junior standing and approval of the department.

Courses for Graduate Students

400. THEORY AND METHOD IN SOCIAL ANTHROPOLOGY. 4 HOURS. Survey of contemporary and historical approaches to problems of field and library research. Prerequisite: Consent of the instructor.

410. ADVANCED STUDY OF KINSHIP. 4 HOURS. Investigation of patrilineal, matrilineal, and bilateral kinship systems; the correlations between kinship systems and social structure; the relationships of ecological factors and kinship organization to rural and urban communities. Reading and research on special problems of kinship, marriage, residence, inheritance, authority patterns, and change. Prerequisite: Consent of the instructor.

411. VISUAL ANTHROPOLOGY: PRINCIPLES. 8 HOURS. Theory and practice of the use of visual media in behavioral science field research. Lectures, workshops, and field projects. Students who are interested in a sequence of courses beginning with Anthropology 411 should arrange with the department for special advisement. Prerequisites: Graduate standing in a social science, formal training or equivalent knowledge of the photographic process, and consent of the instructor.

412. VISUAL ANTHROPOLOGY: FIELD METHODS. 4 HOURS. Ethnographic film production; researching and filming a suitable sociological subject in northern Illinois; workshop in filming and editing techniques. Prerequisites: Graduate standing in a behavioral science, Anth. 411, and consent of the instructor.

413. VISUAL ANTHROPOLOGY: ANALYSIS. 4 HOURS. Ethnographic film editing; workshop in editing techniques; individual guidance in editing students' research films. Prerequisites: Graduate standing in a behavioral science, Anth. 411 and 412, and consent of the instructor.

414. PSYCHOLOGICAL ANTHROPOLOGY. 4 HOURS. Advanced work on the relationships between the psyche, culture, and society; special reference to cross-cultural investigations. Problems of methodology. Prerequisite: Consent of the instructor.

416. VISUAL ANTHROPOLOGY: KINESICS. 4 HOURS. Nonverbal communication; historical survey of the study of nonverbal communication; workshop in recording and analyzing human interactions. Prerequisites: Anth. 411 and consent of the instructor.

427. POLITICAL ANTHROPOLOGY. 4 HOURS. Problems in analysis and description of non-Western political systems and their articulation into modern state systems. The relationship of the levels of political complexity to theories of political behavior. Prerequisite: Consent of the instructor.

430. THEORY AND METHOD IN PHYSICAL ANTHROPOLOGY. 4 HOURS. Genetics and selection as correlated with the adaptive radiation of the primates, particularly the biological, environmental, and cultural factors associated with the evolution of man. Prerequisite: Consent of the instructor.

450. THEORY AND METHOD IN PREHISTORY. 4 HOURS. Aims and methods of archaeological reconstruction; particular attention to paleoecology, the interpretation of archaeological findings in social terms, and the application of scientific knowledge from other fields to archaeological problems. Prerequisite: Consent of the instructor.

480. SEMINAR ON SOCIOLINGUISTICS. 4 HOURS. Same as Linguistics 480. Past and current approaches to sociolinguistics; variations of linguistic structure with social structure among different linguistic groups. Prerequisite: Anth. 380.

490. SEMINAR ON COMPARATIVE SOCIAL INSTITUTIONS IN WESTERN AND NON-WESTERN SOCIETIES. 4 HOURS. May be repeated twice for credit. Each seminar will select for intensive study a single problem relating to such social institutions as social stratification, political organization, warfare, or religion. Prerequisite: Consent of the instructor.

491. SEMINAR ON ETHNOLOGY. 4 HOURS. May be repeated twice for credit. Advanced seminar in the analysis of ethnological data, focusing on the interpretation of field data from selected geographic regions and on correlated theoretical problems. Prerequisite: Anth. 400.

495. DEVELOPMENTAL SOURCES OF ANTHROPOLOGICAL THEORY. 4 HOURS. Seminar on the sources relevant to the current and historical development of anthropological theory primarily as they derive from interaction

among the subfields of anthropology but also as these influence, and are influenced by, other disciplines. Prerequisites: Anth. 400, and 414, 430, or 450.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Prerequisite: Consent of the student's adviser.

BIOENGINEERING

Professors: Irving F. Miller, Head of the Program; Robert C. Arzbaecher, George Bugliarello, Earl E. Gose, Bruce H. McCormick, William Rostoker, Albert B. Schultz

Associate Professors: Gyan C. Agarwal, Joseph C.F. Chow, William D. O'Neill, B.L. Zuber

Assistant Professors: Ike J. Hung (Visiting), John L. Semmlow

The Bioengineering Program offers work leading to the Master of Science and the Doctor of Philosophy.

Specialization in bioengineering trains the student to apply engineering concepts and methods to the life sciences and medicine. Areas covered include the application to living systems of the principles of information processing communication and control theory; cybernetics,   artificial intelligence and pattern recognition; bioinstrumentation, prostheses and artificial organs; and some aspects of biophysics. This program is for graduates of life sciences, physical sciences, or engineering curricula. Students from the life sciences are expected to emphasize mathematics, engineering, and physical sciences in their initial course work; students from the physical sciences are expected to concentrate initially on the life sciences.

Admission Requirements

Master of Science

Applicants for admission to the Master of Science program should have a grade-point average of 4.00 (A=5.00) or better for the last 90 quarter hours of undergraduate work. Applicants with grade-point averages between 3.50 and 4.00 may be admitted upon special recommendation of the program. Practicing engineers who wish to return to school for further graduate instruction may be admitted on a tentative basis if their professional experience makes it appear likely that they will succeed in the program. This tentative admission will be made permanent after the student completes at least 16 quarter hours with a grade-point average of 4.00 or better.

Doctor of Philosophy

The Doctor of Philosophy in Bioengineering is jointly administered by the College of Engineering at the University of Illinois at Chicago Circle and the University of Illinois at the Medical Center through the Intercampus Bioengineering Coordinating Committee. The purpose is to train people to do the research that will develop systems that apply modern technology to problems of living systems and health care.

Applicants for admission to the Doctor of Philosophy program must be superior students who are highly motivated. They must also meet the entrance requirements of the appropriate Graduate College (UICC or UIMC.) The program is designed primarily for students with degrees in physical sciences, engineering, mathematics, biology, or medicine. Students from other areas will also be encouraged to apply if their backgrounds indicate a reasonable chance of success in the program.

Since students will be entering the program from a wide variety of disciplines, many will have deficiencies in a number of important areas. To remove any deficiencies in prerequisites or background requirements, the student may be required to take undergraduate or specialized remedial courses, chosen in consultation with his adviser.

Degree Requirements

Master of Science

1. A minimum of 48 quarter hours of graduate credit is required for graduation.
2. A grade-point average of at least 4.00 is required for the Master of Science. Credit is not given for a course in which the grade is lower than C.
3. A student admitted to the M.S. program in bioengineering, will be assigned a program adviser, who will consult with him in the selection of his elective courses. Progress toward completing the degree requirements for the M.S. in bioengineering will be recorded only with the approval of the student's adviser.
4. A student who enters the M.S. program in bioengineering must be continuously registered for a minimum of 2 hours each quarter in any three quarters out of the calendar year between the time he enters the program and the time he receives his M.S.
5. Required Courses:
    Biological Sciences 363, 364, Animal Physiology I and II (or the equivalents), 10 Hours
    Bioengineering 498, Seminar in Bioengineering, 1 hour
    At least 12 quarter hours of 400-level courses must be taken, including at least 8 hours of 400-level courses in bioengineering.

6. Students will be required to write an acceptable M.S. thesis. Bioengineering 499, Thesis Research, must be taken for a minimum of 8 quarter hours.

Doctor of Philosophy

The Ph.D. program in bioengineering requires 144 quarter hours of credit beyond the baccalaureate, consisting of a reasonable distribution of course work between UICC and UIMC. Of this total at least 32 quarter hours must consist of 400-level courses and an additional 48 quarter hours of thesis research. A student who enters the program with an M.S. may be allowed to transfer up to 48 quarter hours of credit toward the degree. Specific course requirements for students entering with the M.S. may be waived if the student can demonstrate equivalent background.

The four areas of concentration:
1. Health Care Delivery
2. Medical Instrumentation
3. Physiological Systems and Biocontrol
4. Prosthetics and Artificial Organs

The student must complete in one of these areas at least 36 quarter hours of required courses and electives chosen in consultation with his adviser. In addition to these areas of concentration, a candidate with other interests may design his own area of concentration in consultation with his adviser, subject to approval by the candidate's doctoral advisory committee.

These courses are required of all students:
At UIMC:

Physiology 369, 370, 371—Human Physiology	15 hours
AT UICC;	
Internship	12 hours
Bioengineering 354, 379, and 498	9 hours
Total	36 hours

A qualifying interview, held after the student completes 24 quarter hours and before he completes 36, will determine the depth of the student's previous academic experience. Near the completion of his formal course work, the student will submit for faculty approval a thesis proposal. At that time, the student will also take a preliminary examination to determine the depth of his knowledge in one of the broad academic areas covered by this program. When he successfully passes the preliminary examination, the student will be expected to continue and to intensify the research leading to

the doctoral thesis. Finally, upon completion of the thesis the student will be examined by a faculty committee appointed by the Intercampus Coordinating Committee.

Courses for Graduate and Advanced Undergraduate Students

Note: Many courses pertinent to the graduate program in bioengineering are offered by the other UICC engineering departments and at UIMC. Students should consult the appropriate listings and contact the Bioengineering Program for details.

307. **CYBERNETICS I. 4 HOURS.** Introduction to artificial intelligence and pattern recognition by computer. Programs for playing games, proving theorems, answering questions, and making medical diagnoses. Property selection and decision making techniques. Prerequisites: Math. 195 and either 250 or 370.

350. **PROSTHESES AND ARTIFICIAL ORGANS. 4 HOURS.** The special problems encountered in the design of organ replacements, circulatory assist devices, artificial kidneys and other organ systems. Prerequisites: BioE. 200, BioS. 364, MatE. 230, and EnrE. 211; or the equivalents.

352. **BIOCONTROL. 3 HOURS.** Demonstration of the applicability of the control systems theory to physiological systems, including the pupil system, eye and hand movement systems, by utilizing such techniques as Fourier analysis, Nyquist stability criteria and cross-correlation. Prerequisites: InfE. 311, and 383 or 384.

353. **BIOCONTROL LABORATORY. 3 HOURS.** Experimental counterpart of Bioengineering 352. Motor coordination, crayfish photoreceptor, human pupil, eye movement. Prerequisite: Credit or registration in BioE. 352.

354. **BIOINSTRUMENTATION: TRANSDUCERS. 4 HOURS.** Consideration of energy conversion; detailed discussion of transducers used in biological research. Prerequisites: InfE. 240 and BioE. 352.

355. **ENGINEERING BIOPHYSICS. 4 HOURS.** Introduction to biophysical mechanisms at the molecular, cellular, and organ levels. Passive and active properties of excitable tissue; quantitative descriptions and modeling of biophysical mechanisms; cell-to-cell transmission and ionic mechanisms. Prerequisites: Math. 300, Phys. 231, and any two of InfE. 100, 101, 102.

356. **MATERIALS IN BIOENGINEERING. 4 HOURS.** Analysis of materials problems associated with prostheses and other implanted devices (both medical and dental). Prerequisites: MatE. 230, InfE. 383 or 384.

359. **NEUROANATOMY. 5 HOURS.** An introduction to the neurological organization of the mammalian central nervous system.

379. **REAL-TIME DATA PROCESSING. 4 HOURS.** Theory and techniques of data processing using analog and digital computers. Emphasis on the unique

computational problems presented by biological data, illustrating the practical use of communication theory. Prerequisites: Math. 195, 220.

391. SEMINAR. 1 TO 4 HOURS. Topics to be arranged.

393. SPECIAL PROBLEMS. 2 TO 4 HOURS. May be repeated for credit. Special problems or reading by arrangement with the faculty.

Courses for Graduate Students:

408. CYBERNETICS II. 4 HOURS. Comparison of natural and artificial intelligence and pattern recognition. Information processing in nets, image processing. Models of retinal and brain structure, thought, learning, and memory. Prerequisite: BioE. 307.

409. PATTERN RECOGNITION TECHNIQUES AND SYSTEMS. 4 HOURS. Functions and systems of functions, such as machines designed to learn the common properties of a set of N-dimensional vectors of patterns representing samples of a class and to recognize a new vector as a possible member of the class by noting properties common to the set of sample vectors. Prerequisites: SysE. 372 or BioE. 307.

451. ADVANCED BIOCONTROL. 4 HOURS. Mathematical modeling and analysis of biological systems, emphasizing techniques of control engineering. Prerequisite: BioE. 353.

453. ADVANCED SYSTEMS PHYSIOLOGY. 4 HOURS. Intensive treatment of selected neurophysiological topics; emphasis on systems organization. Prerequisite: BioE. 353.

457. ANALYSIS OF VISUAL SYSTEMS. 4 HOURS. An advanced course covering in detail important research areas of the visual system. The fundamental importance of physical, chemical, and physiological processes as related to vision is stressed. Prerequisite: Consent of the instructor.

484. BIOINSTRUMENTATION: SYSTEMS. 3 HOURS. Analysis of systems used in biological and medical instrumentation. General principles and specific electrical, mechanical, and optical aspects of instrumentation systems.

495. INDIVIDUAL RESEARCH. 2 TO 4 HOURS. May be repeated. Research on special problems not included in graduate thesis. Prerequisite: Consent of the instructor.

498. SEMINAR IN BIOENGINEERING. 1 TO 4 HOURS. May be repeated. Systematic review of special topics; emphasis on current research. Prerequisite: Consent of the instructor.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated.

BIOLOGICAL SCIENCES

Professors: Elmer B. Hadley, Head of the Department; G. Benjamin Bouck, Donald A. Eggert, Sidney F. Glassman, Bernard Greenberg, Helene N. Guttman, Albert S. Rouffa, Stanley K. Shapiro, Rolf Singer (Visiting), Eliot B. Spiess, Thomas N. Taylor

Associate Professors: Louise Anderson, David Bardack, James A. Bond, Howard E. Buhse, Jr., Michael R. Cummings, M.A.Q. Khan, David B. Mertz, Darrel L. Murray, John A. Nicolette, Jack H. Prost, Charles N. Spirakis, Robert B. Willey, Ruth L. Willey

Assistant Professors: Shepley S. C. Chen, Merrill Gassman, Manuel Goldman, John F. Lussenhop, William A. Mego, Dallice I. Mills, David G. Penney, Thomas W. Seale, A. Spencer Tomb, Heman J. Witmer

Adjunct Professors: Douglas Grahn (Argonne National Laboratory), Marion T. Hall (Morton Arboretum), Robert F. Inger (Field Museum of Natural History), Bernard N. Jaroslow (Argonne National Laboratory), Jerry R. Kline (Argonne National Laboratory), Herbert E. Kubitschek (Argonne National Laboratory), Carl Peraino (Argonne National Laboratory), Fritz Schlenk (Argonne National Laboratory), Warren K. Sinclair (Argonne National Laboratory), John F. Thomson (Argonne National Laboratory)

The Department of Biological Sciences offers work leading to the Master of Science in Biology and, in an intercampus program with the School of Life Sciences at the Urbana-Champaign campus of the University of Illinois, work leading to the Doctor of Philosophy in Biology.

Admission Requirements

Applicants must have a Bachelor of Arts or a Bachelor of Science degree from an accredited college or university and a grade-point average of at least 4.00 (A=5.00) for the last 90 quarter hours of undergraduate study. A student whose average is between 3.75 and 4.00 may petition for consideration.

Applicants must have 30 quarter hours in biological sciences, excluding 100-level (introductory) courses, that indicate a broad, well-balanced selection of courses in biology.

Collateral Requirements: Chemistry (including two quarters of organic chemistry), one year each of physics and mathematics, preferably including introductory calculus. Deficiencies determined by the Graduate Committee of the Department of Biological Sciences and the student's adviser must be made up early in the student's residence.

Applicants who have majored in fields other than biological sciences are encouraged to contact the department prior to making formal application for admission.

All students who apply for admission must submit the following:

A completed application form.

Complete transcripts of undergraduate (and any graduate) course work.

Three letters of recommendation, preferably from professors who are familiar with the student's recent work.

A statement of about 250 words presenting the applicant's reasons for desiring to take graduate work in biological sciences and the relationship of this work to his professional and other goals.

Graduate Record Examination scores for both the Aptitude Test and the Advanced Test in his major field.

Degree Requirements

Master of Science

When a student is admitted to the master's program, a temporary faculty adviser is appointed by the graduate coordinator in consultation with the student. Within the first two weeks of his first quarter an introductory interview will be held by an interview committee that is individually appointed for each student. This committee, consisting of three faculty members, one of whom will be the student's temporary faculty adviser, will represent at least three of the following four general areas:

1. Genetics, including evolutionary biology.
2. Cell physiology and biochemistry.
3. Organismic structure, function, and development.
4. Environmental and population biology.

The committee will review the student's credentials, assess his academic interests, and, together with the student, plan his course work. Academic deficiencies revealed by the interview should be eliminated as quickly as possible.

Candidates for the master's degree must complete 48 hours of graduate-level courses, of which at least 18 hours must be in 400-level courses. The student may elect one of two options: the first emphasizes independent research and is designed for those who may proceed toward the doctorate, the second is for the student whose prime interest lies in teaching and education.

For either of these options the student will select an area of concentration within the biological sciences and, in consultation with the graduate student coordinator, will choose a principal adviser no later than the end of the second quarter. By the end of the third quarter in residence an advisory committee, whose function will be to oversee the student's academic progress, will be appointed by the Dean of the Graduate College on the recommendation of the principal adviser and the Graduate Program Committee. The composition of this committee is described under each of the options.

Option 1

The advisory committee will consist of the principal adviser and at least two other faculty members from disciplines pertinent to the student's research interest. A final examination, to be taken after all course work and the thesis are completed, will be conducted by the student's advisory committee and will cover his thesis research and the subject matter from the biological sciences disciplines related to his area of specialization.

A maximum of 16 quarter hours in Biological Sciences 499, Thesis Research, may be credited toward the degree.

Option 2

The advisory committee will consist of the principal adviser, who is a specialist in biological sciences education, and at least two other faculty members from disciplines pertinent to the student's area of concentration. The candidate must complete the following:
1. At least 8 hours of course work in his area of concentration and selected in consultation with his advisory committee.
2. At least 8 hours of Biological Sciences 493 in the form of an extended laboratory research project (a thesis is not required).
3. A minimum of 12 hours of course work in biological sciences education, including Biological Sciences 403.

Additional courses should be selected by the student, in consultation with his committee, to provide a broad biological sciences background. The student who elects Option 2 will write a final examination covering his general knowledge of biology, his specific area of biological sciences concentration, and the mechanisms for communicating biological sciences concepts.

Courses for Graduate and Advanced Undergraduate Students

300.   SEMINAR. 0 TO 1 HOUR. Faculty and visiting biologists discuss results of their
       research programs before staff and students at weekly meetings. Attendance of

majors at all meetings is strongly encouraged. Prerequisites: Biological sciences major, junior standing.

303. QUANTITATIVE BIOLOGY I. 5 HOURS. Quantitative ideas and mathematical models in the development of biological theory and as a basis for biological experimentation. Lecture and laboratory. Prerequisites: Math. 131 and either BioS. 240 and 241 or BioS. 315.

304. CYTOLOGY LABORATORY. 3 HOURS. Advanced cytology; emphasis on instrumental methods. Prerequisites: BioS. 261 and concurrent registration in BioS. 309.

305. QUANTITATIVE BIOLOGY II. 5 HOURS. Formal aspects of biological experimentation, including the basic aspects of experimental design; interpretation of biological data. Lecture and laboratory. Prerequisite: BioS. 303.

307. BIOLOGICAL METHODS FOR TEACHERS. 3 HOURS. Investigation of methodological subject matter, conducted primarily as a practicum; emphasis on the development of competencies. Prerequisites: Senior standing and 40 hours of biological sciences.

309. CYTOLOGY. 3 HOURS. Structure and function of cells as revealed through historical development and modern research techniques. Lecture. Prerequisite: Two years of biological sciences.

313. DEVELOPMENTAL BIOLOGY. 4 HOURS. Principles governing growth and differentiation at molecular, fine structural, cellular, and organismic levels. Lecture and laboratory. Prerequisite: One year of biological sciences.

314. PLANT DEVELOPMENT. 5 HOURS. Analysis of growth in plants; modern concepts of cellular differentiation; control of plant development by intrinsic, hormonal, and environmental factors. Lecture and laboratory. Prerequisites: Chem. 234, BioS. 232, 313, or 333, and consent of the instructor.

315. PRINCIPLES OF ECOLOGY. 3 HOURS. Composition and distribution of biotic communities, plant and animal; emphasis on the interplay of physical and biological factors of the environment. Prerequisites: One year of biological sciences and concurrent registration in BioS. 324 or 380.

316. INVERTEBRATE PALEONTOLOGY. 4 HOURS. Same as Geological Sciences 316. Phylogeny, morphology, and ecology of the fossil invertebrates. Prerequisites: BioS. 218 and consent of the instructor.

317. COMMUNITY ECOLOGY. 5 HOURS. Concepts of trophic structure, niche, competition, coexistence, and diversity are used to examine theories of community origin, change, structural-functional patterns, and distribution; emphasis on experimental bases and current problems. Prerequisites: BioS. 315 and either 324 or 380.

318. VERTEBRATE PALEONTOLOGY. 4 HOURS. Same as Geological Sciences 318. Phylogeny, morphology, and ecology of the fossil vertebrates. Prerequisites: BioS. 281 and consent of the instructor.

319. PALEOBOTANY. 5 HOURS. Same as Geological Sciences 319. Structure, phylogeny, and stratigraphic distribution of representative fossil plants. Lecture, laboratory, and field trips. Prerequisite: One year of biological sciences.

320. FIELD BOTANY. 5 HOURS. Flora of the Chicago region. Lecture, laboratory, field trips. Prerequisite: One year of biological sciences.

321. PLANT GEOGRAPHY OF NORTH AMERICA. 4 HOURS. Ecological and systematic treatment of vegetation regions and principal subdivisions; emphasis on environmental factors and floras. Prerequisite: BioS. 220 or 315.

324. PLANT ECOLOGY LABORATORY. 2 HOURS. Special attention to vegetation and environment of the Chicago region. Laboratory and field trips (one weekend trip plus field trips on Saturdays in the fall, Sundays in the spring). Prerequisite: Concurrent registration in BioS. 315.

325. PLANT ANATOMY. 4 HOURS. Examination of the internal structure of vascular plants; emphasis on structure and function. Lecture and laboratory. Prerequisite: One year of college biology or the equivalent.

326. PLANT PHYSIOLOGY I. 3 HOURS. Photobiology of photosynthesis, photosynthetic carbon metabolism, formation of the photochemical apparatus, and respiration. Prerequisites: One year of biological sciences and Chem. 234.

327. PLANT PHYSIOLOGY II. 3 HOURS. Water relations, translocation of solutes, growth, flowering, and phytohormones. Prerequisites: One year of biological sciences and Chem. 234.

328. PLANT PHYSIOLOGY LABORATORY I. 2 HOURS. Laboratory techniques. Prerequisite: Concurrent registration in BioS. 326.

329. PLANT PHYSIOLOGY LABORATORY II. 2 HOURS. Laboratory techniques. Prerequisite: Concurrent registration in BioS. 327.

330. PRIMATE EVOLUTION. 4 HOURS. Same as Anthropology 330. Paleontology and systematics of fossil primates as illuminated by the anatomy, ecology, and behavior of the living populations. Prerequisite: Anth. 231 or BioS. 282 or 318.

331. HUMAN EVOLUTION. 4 HOURS. Same as Anthropology 331. Phylogeny of the primate order and the problems of speciation; particular emphasis on the relative roles of culture and nature as selective forces in human evolution. Prerequisite: Anth. 230 or 231, or BioS. 282 or 318.

332. MORPHOGENESIS IN HIGHER PLANTS. 3 HOURS. Morphogenesis, growth, and differentiation of vascular plants and bryophytes. Emphasis on experimental approaches to plant development at the molecular, cellular, and organismic levels. Lecture. Prerequisites: Chem. 234 and BioS. 313 or 333.

333. MORPHOLOGY OF VASCULAR PLANTS. 4 HOURS. Structure, reproduction, and evolutionary history of representative vascular plants, including psilopsids,

lycopsids, sphenopsids, ferns, gymnosperms, and angiosperms. Lecture and laboratory. Prerequisite: One year of biological sciences.

334. EXPERIMENTAL PHYCOLOGY. 3 HOURS. Survey of major algal groups; particular emphasis on the use of algae as experimental organisms. Prerequisites: BioS. 100, 101, 102, and either 261 or 361 or the equivalent.

335. LABORATORY IN EXPERIMENTAL PHYCOLOGY. 2 HOURS. Field experience in collecting and identifying common algal forms; practical experience in the use of algae as experimental organisms. May be taken concurrently with Biological Sciences 334.

342. CYTOGENETICS. 4 HOURS. Chromosomal phemomena involved in the mechanics of genetics, structure of genetic material, and the role chromosomal variation plays in the evolution of races and species. Lecture and laboratory. Prerequisites: BioS. 240 and 241.

343. POPULATION GENETICS. 3 HOURS. Genetics dynamics for animal, plant, and human populations: mating systems, selection, sampling, and mutation. Lecture and recitation. Prerequisites: BioS. 240 and 241, Math. 130, and credit or concurrent registration in statistics.

344. EXPERIMENTAL POPULATION GENETICS. 3 HOURS. Discussion of experimental and field empirical studies estimating genetic parameters, influence of selection, and other evolutionary forces on genotypes in populations. Lecture, laboratory, and discussion. Prerequisite: BioS. 343.

345. EVOLUTION. 4 HOURS. Mechanisms of genetic and phenotypic stability and change in populations and species; modes of speciation; rationale for classification systems; nature of taxonomic characters. Prerequisites: One year of biological sciences and BioS. 240, 241.

347. PHYSIOLOGICAL GENETICS. 4 HOURS. Consideration of heredity at the biochemical level; particular reference to mutation, the transcription and translation of genetic information, and genetic regulatory mechanisms. Lecture. Prerequisites: BioS. 240, 241, and 370.

349. EVOLUTIONARY THEORY. 3 HOURS. Analysis of evolutionary mechanisms in plants and animals; variation and differentiation in populations and species; origins of superspecific taxa. Prerequisites: BioS. 315 and 345.

350. ADVANCED MICROBIOLOGY. 5 HOURS. Modern contributions to the cellular anatomy, physiology, and genetics of microorganisms. Lecture and laboratory. Prerequisite: BioS. 250 or 261 or the equivalent.

351. PRINCIPLES OF CELL AND TISSUE CULTURE. 5 HOURS. Methods for primary isolation of plant and animal tissue and subsequent cultivation. Uses of cells in cultures as experimental tools. Prerequisites: BioS. 250 and 261.

353. CHEMICAL BIOGENESIS. 4 HOURS. Same as Chemistry 353. Biosynthesis of important biological compounds. Lecture and discussion. Prerequisite: Chem. 234.

356.   MYCOLOGY. 4 HOURS. Analysis of the morphology, physiology, and genetics of fungi as related to the taxonomy and phylogeny of fungi. Lecture and laboratory. Prerequisite: One year of biological sciences.

359.   NEUROANATOMY. 5 HOURS. Same as Information Engineering 359. Introduction to the neurological organization of the mammalian central nervous system. Prerequisites: BioS. 280 and consent of the instructor.

361.   CELL PHYSIOLOGY II. 3 HOURS. Emphasizes the structure and functional interactions of cell organelles. Organelle development, physiology, and organization is considered particularly in the context of current literature. Prerequisite: BioS. 261 or the equivalent.

362.   LABORATORY IN CELL PHYSIOLOGY II. 2 HOURS. Practical experience with techniques and analytical methods in cell physiology at an advanced level. An experimental approach is emphasized. Prerequisite: BioS. 261 or the equivalent.

363.   ANIMAL PHYSIOLOGY I. 5 HOURS. Same as Information Engineering 383. The role of the digestive, circulatory, respiratory, and osmoexcretory systems in the maintenance of organismic homeostasis. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: BioS. 261.

364.   ANIMAL PHYSIOLOGY II. 5 HOURS. Same as Information Engineering 384. The role of the muscular, sensory, nervous, and endocrine systems in the maintenance of organismic integration. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: BioS. 261.

366.   MICROBIAL PHYSIOLOGY I. 5 HOURS. Organization of physiological processes in various groups of microorganisms; comparative biochemistry of energy-yielding mechanisms; biosynthesis of macromolecules; ecological implications of microbial metabolism. Lecture, discussion, laboratory. Prerequisite: BioS. 250 or the equivalent.

368.   VIROLOGY. 4 HOURS. Nature of viruses and their morphology, chemical composition, assay, host-parasite interactions, and life cycles. Lecture, dicussion. Prerequisite: BioS. 250 or 261.

370.   BIOCHEMISTRY I. 4 HOURS. Same as Chemistry 350. Chemistry of biological systems, including proteins and enzymes. Prerequisites: Chem. 119 or 121 and credit or registration in Chem. 235.

371.   BIOCHEMISTRY II. 4 HOURS. Same as Chemistry 351. Continues Biological Sciences 370. Carbohydrate and lipide metabolism. Electron transport. Prerequisite: BioS. 370.

372.   BIOCHEMISTRY III. 4 HOURS. Same as Chemistry 352. Continues Biological Sciences 371. Metabolism of amino acids, nucleic acids, proteins, and the biosynthesis of biological macromolecules. Prerequisite: BioS. 371.

373. BIOCHEMISTRY III LABORATORY. 2 HOURS. Experiments in macromolecular biochemistry, including cell fraction, enzyme regulation, use of radioactive isotopes, and protein synthesis. Prerequisite: Concurrent registration in BioS. 372 or Chem. 352.

375. COMPARATIVE VERTEBRATE PHYSIOLOGY I. 4 HOURS. Comparison of selected physiological adaptations of various vertebrate groups to the factors of the environment at the whole animal and organ system levels. Lecture and laboratory. Prerequisite: BioS. 275 or BioS. 363 and 364 or the equivalent.

377. ENDOCRINOLOGY. 5 HOURS. Animal hormones in the control of integration, homeostasis, growth, and development. Lectures and laboratory. Prerequisite: BioS. 364.

380. ANIMAL ECOLOGY LABORATORY. 2 HOURS. Population and community assemblages of the Chicago region. Laboratory and field trips are required (one weekend trip plus field trips on Saturdays in the fall, Sundays in the spring). Prerequisite: Concurrent registration in BioS. 315.

381. ENVIRONMENTAL TOXICOLOGY. 5 HOURS. Ecological, physiological, health, and economic aspects of environmental toxicants. Lectures, laboratories, discussions, field trips. Prerequisite: BioS. 261 or 363 or the equivalent.

382. ENVIRONMENTAL CONSERVATION. 4 HOURS. Applied ecology of the use of renewable natural resources; special emphasis on biotic problems of land, water, and air management; pollution, population increase, multiple-use concept, and land ethics. Lecture, discussion, and term paper. Prerequisites: Credit or concurrent registration in BioS. 315, and 324 or 380.

384. THE INVERTEBRATE PROTOSTOMES. 5 HOURS. Comparative study of structure, development, behavior, classification, and evolution of the annelid-arthropod line of invertebrates; emphasis on parasitism. Lecture and laboratory. Prerequisite: One year of biological sciences.

385. THE INVERTEBRATE RADIATA AND DEUTEROSTOMES. 5 HOURS. Comparative study of structure, development, classification, and evolution of the radiate and chordate lines of invertebrates; emphasis on colonial specialization. Lecture, laboratory, and research topic. Prerequisite: BioS. 384.

388. GENERAL ENTOMOLOGY. 5 HOURS. Introduction to the morphology, physiology, classification, behavior, and evolution of insects. It is recommended that students planning to take this course begin collecting insects the previous spring and summer. Lecture and laboratory. Prerequisite: 12 hours of biological sciences.

389. PRINCIPLES OF PROTOZOOLOGY. 5 HOURS. Introduction to the comparative morphology, physiology, and systematics of the protozoa, including discussion of advances in major areas of current research. Lecture and laboratory. Prerequisite: One year of biological sciences.

393. FUNCTIONAL ANIMAL MORPHOLOGY. 4 HOURS. Functional analysis of selected invertebrate and vertebrate organ systems applied to problems of comparative structure, adaptation, and phylogeny. Lecture and laboratory. Prerequisites: Senior standing and consent of the instructor.

395. ZOOGEOGRAPHY. 3 HOURS. Investigation of geological and biological factors leading to past and present distribution patterns of animals; emphasis on current experimental methods to elucidate mechanisms of origin and diversification of island and continental faunas. Prerequisite: Senior standing.

397. ICHTHYOLOGY AND HERPETOLOGY. 5 HOURS. Ecology, speciation, and adaptive modification of fishes, amphibians, and reptiles as demonstrated from experimental and descriptive studies. Prerequisite: Any one of BioS. 218, 240-241, 280, 281.

Courses for Graduate Students

401. FOUNDATIONS OF BIOLOGICAL THOUGHT. 4 HOURS. Presentation and analysis of some of the fundamental concepts of the mainstreams of biological thought.

402. PATTERNS OF BIOLOGICAL ENQUIRY. 4 HOURS. Contemporary and developing ideas in biology, utilizing blocks of integrated research papers to analyze the functioning of selected ideas as they influence the design, execution, and interpretation of research problems. Prerequisite: BioS. 401.

403. ENQUIRY PROCESSES IN THE CLASSROOM. 4 HOURS. The insights derived from Biological Sciences 401 and 402 are used in preparing inquiry-oriented materials for presentation in the classroom. Prerequisite: BioS. 402.

404. METHODS IN CELLULAR PHYSIOLOGY. 5 HOURS. May be repeated once for credit with the consent of the instructor. Analytical techniques and instrumentation used in microbiology, cell biology, and physiology. Practical and theoretical problems associated with these techniques are considered. Prerequisites: BioS. 261, 262, and 372 or the equivalents. Concurrent registration is allowed in BioS. 372.

406. BIOLOGICAL ULTRASTRUCTURE. 5 HOURS. Discussion, instrumentation, and special topics in fine structure of plant and animal cells and cell products. Prerequisites: BioS. 261, 309, organic chemistry, and consent of the instructor.

408. HISTOCHEMISTRY. 5 HOURS. Analysis of cell and tissue structure by histochemical methods. Prerequisites: BioS. 261, 309, Chem. 234, and consent of the instructor.

411. DISCUSSIONS IN PALEOBIOLOGY. 1 HOUR. May be repeated for credit. Consideration of selected topics and current research literature in paleobiology. Prerequisite: Consent of the instructor.

413. PROBLEMS IN EVOLUTIONARY PALEONTOLOGY. 4 HOURS. Same as Geological Sciences 413. Seminar on current problems. Discussion of evidence and mechanisms of change, such as rates of evolution, population structure, and extinction as shown by the vertebrate fossil record. Prerequisite: Consent of the instructor.

415. PRINCIPLES OF MORPHOGENESIS. 4 HOURS. Analysis of factors controlling growth and differentiation in unicellular and multicellular organisms. Prerequisites: BioS. 240, 241, and 313.

416. EVOLUTION OF PTERIDOPHYTES. 4 HOURS. Basic structure and major features of evolution of lycopods, sphenopsids, and ferns. Prerequisites: BioS. 333 or the equivalent, and consent of the instructor.

417. EVOLUTION OF GYMNOSPERMS. 4 HOURS. Basic structure and major features of naked seeded plants. Prerequisites: BioS. 333 or the equivalent, and consent of the instructor.

418. ANGIOSPERM MORPHOLOGY. 4 HOURS. Basic structure and major features of evolution within the flowering plants. Prerequisites: BioS. 333 or the equivalent, and consent of the instructor.

419. TOPICS IN THE MORPHOLOGY AND EVOLUTION OF PLANTS. 1 HOUR. Seminar. Prerequisites: BioS. 333 or the equivalent; 416, 417, or 418, and consent of the instructor.

420. ADVANCED VERTEBRATE PALEONTOLOGY. 4 HOURS. Same as Geological Sciences 420. Given as three different courses. May be repeated twice for credit. Advanced treatment of the functional morphology, paleoecology, and phylogeny of the various vertebrate groups: fishes, amphibians and reptiles, and mammals. Prerequisites: BioS. 282 and 318.

422. PHYSIOLOGICAL ECOLOGY OF PLANTS. 4 HOURS. Physiological investigation of climatic and edaphic differentiation; emphasis on the ecophysiological adaptations of species to their environments. Prerequisites: BioS. 315, 324, or 380, and one quarter of plant physiology.

423. DISCUSSIONS IN ECOLOGY AND BEHAVIOR. 2 HOURS. May be repeated for credit up to 8 hours. Consideration of selected topics, current literature, and recent advances in ecology and behavior. Prerequisite: Consent of the instructor.

424. ADVANCED PALEOBOTANY. 4 HOURS. Problems in the structure and phylogeny of representative fossil plant groups. Lecture, laboratory, occasional field trip. Prerequisite: BioS. 319.

426. BIOCHEMICAL SYSTEMATICS. 4 HOURS. Analysis of the utilization of comparative biochemical data in determining evolutionary relationships among groups of plants and animals. Prerequisites: BioS. 345 and 353.

427. ADVANCED TAXONOMY OF FLOWERING PLANTS. 4 HOURS. Emphasis on theories and data for evolution within groups of flowering plants. Prerequisites: BioS. 345 and consent of the instructor.

428. INTERMEDIARY METABOLISM IN PLANTS. 3 HOURS. Pathways of carbon metabolism, enzymes involved, and control mechanisms. Prerequisite: BioS. 329 or Chem. 351.

429. TOPICS IN SYSTEMATIC BOTANY. 4 HOURS. Specialized systematic studies of the larger, more important families of flowering plants. Lecture, laboratory, and field trips. Prerequisite: BioS. 220 or 315 or 345.

430. POPULATION ECOLOGY. 3 HOURS. The ecology of plant and animal populations. Life histories and population growth, competition, predator-prey systems, population movement, and ecological genetics; emphasis on populational modeling. Prerequisites: BioS. 240, 241, 315, 324 or 380, and consent of the instructor.

436. PHOTOBIOLOGY. 3 HOURS. Photobiological processes, including vision, photosynthesis, ultraviolet light as a mutagen, bioluminescence, phototropisms, and photomorphogenesis. Basic techniques in photobiological research. Prerequisites: BioS. 328, 329, and consent of the instructor.

437. ORGANELLE BIOGENESIS. 3 HOURS. May be repeated once for credit. Organization, development, and reproduction of plastids and mitochondria, including growth, differentiation, continuity, genetics, and autonomy; origin and evolutionary significance of these organelles. Prerequisites: BioS. 261, Chem. 351, or the equivalent, and consent of the instructor.

438. EXPERIMENTAL PLANT SYSTEMATICS. 4 HOURS. Evolutionary mechanisms and pathways in higher plants; analysis of genetic chromosomal, morphological, and physiological properties of natural assemblages at and below the species level of divergence. Lecture and laboratory. Prerequisites: BioS. 342 and 349.

440. SEMINAR ON GENETICS. 2 HOURS. May be repeated for credit. Discussion of research literature in the field. Student topics assigned. Prerequisites: BioS. 240, 241, and consent of the instructor.

442. PROBLEMS IN POPULATION GENETICS. 3 HOURS. May be repeated for credit. Lecture and discussion of research literature in the field. Prerequisites: BioS. 343 and 344.

445. DISCUSSION IN SYSTEMATICS AND EVOLUTION. 1 HOUR. May be repeated for credit. Consideration of current literature and of recent advances in the field of systematic biology. Prerequisite: Consent of the instructor.

446. DEVELOPMENTAL GENETICS. 4 HOURS. Principles of genome function during gametogenesis and the onset of differentiation; patterns and mechanisms of gene regulation in differentiated cells. Prerequisites: BioS. 240 and 313.

447. THE REGULATION OF GENE EXPRESSION. 4 HOURS. Analysis of control of gene function at the molecular level, including comparison of eucaryotic to procaryotic systems, positive and negative control at the transcriptional level, translational control, allosterism. Prerequisites: BioS. 240, 372. Biological Sciences 347 is recommended.

450.   TOPICS IN MICROBIAL PHYSIOLOGY. 4 HOURS. Modern contributions to
        microbiology, including the ultrastructure of the bacterial cell, metabolism and
        control mechanisms, bacterial genetics, and cell-viral systems. Lecture and
        laboratory. Prerequisite: BioS. 350.

451.   INSECT MICROBIOLOGY. 5 HOURS. Host microbe associations and their
        commensal, pathogenic, and other interactions. Virus, protozoan, and bacterial
        associations. Prerequisites: BioS. 250 and 388.

452.   INSECT PHYSIOLOGY. 5 HOURS. Structure, function, and adaptive aspects of
        the insect exoskeleton and organ systems; growth, differentiation, and
        reproduction. Prerequisite: BioS. 388.

455.   TOPICS IN MOLECULAR BIOLOGY. 3 HOURS. May be repeated for credit.
        Selected topics emphasizing molecular studies involved in such diverse biological
        areas as virology, genetics, immunology, photobiology, pharmacology,
        exobiology. Prerequisites: BioS. 240, 241, 250, 261, and consent of the
        instructor.

456.   BACTERIAL PHOTOSYNTHESIS. 3 HOURS. Structure and function of the
        photochemical apparatus in the photosynthetic bacteria; photosynthetic carbon,
        nitrogen, hydrogen, and sulfur metabolism in the bacteria. Prerequisites: BioS.
        250, 328, and 329.

468.   MICROBIAL PHYSIOLOGY II. 4 HOURS. May be repeated for a total of 8
        hours. Biochemistry of growth of microorganisms; formation of various microbial
        structures; biosynthesis of major cellular constituents; metabolic regulation;
        kinetics of microbial growth. Lecture, discussion, laboratory. Prerequisite: BioS.
        366.

471.   COMPARATIVE VERTEBRATE PHYSIOLOGY II. 4 HOURS. Comparison of
        selected physiological adaptations of various vertebrate groups to the factors of
        the environment at the tissue and cellular levels. Lecture and laboratory.
        Prerequisite: BioS. 375 or an equivalent physiology course.

472.   EXPERIMENTAL ANIMAL PHYSIOLOGY. 4 HOURS. May be repeated once
        for credit. Selected topics in experimental surgery and pharmacodynamics.
        Prerequisite: BioS. 363 or 364.

473.   COMPARATIVE INVERTEBRATE PHYSIOLOGY. 5 HOURS. Adaptive
        mechanisms of invertebrate animals in their major kinds of habitats. Lecture and
        laboratory. Prerequisite: BioS. 385.

474.   ADVANCED INVERTEBRATE PHYSIOLOGY. 5 HOURS. Detailed study of the
        physiology of respiration and metamorphosis in invertebrates and of their
        adaptations in toxic environments. Lecture and laboratory. Prerequisite: BioS.
        473.

486.   ADVANCED INVERTEBRATE ZOOLOGY. 5 HOURS. May be repeated for
        credit with the consent of the instructor. Selected topics in currently advancing

areas of descriptive and experimental invertebrate zoology. Emphasis on recent comparative research in such areas as behavior, embryogenesis, circadian rhythms, and ecological interactions. Lecture, laboratory, directed laboratory or field research. Prerequisite: BioS. 384 or 385.

489. ADVANCED PROTOZOOLOGY. 4 HOURS. Consideration of selected topics in modern protozoological research. Prerequisite: BioS. 389.

490. PROBLEMS IN VERTEBRATE MORPHOLOGY. 4 HOURS. Feeding and locomotory mechanisms of selected vertebrates. Dissection, experimentation, and seminar presentation of analyzed results. Laboratory and discussion. Prerequisite: BioS. 393 or the equivalent.

492. SEMINARS ON BIOLOGY. 1 TO 3 HOURS. Credit varies according to the seminar offered. May be repeated for credit. Selected aspects of biological sciences.

493. PROBLEMS IN MODERN BIOLOGY. 2 TO 8 HOURS. May be repeated for credit. Not to be used for thesis research. Guided study of selected topics with research potential in specific fields of advanced modern biology. Prerequisite: Consent of the instructor.

495. GRADUATE SEMINAR. NO CREDIT. Thesis presentation by advanced students; occasional seminar by staff and invited speakers. Required of graduate students every quarter.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Work in a number of fields offered under the direction of faculty members with appropriate graduate standing.

Chemistry

Professors: William F. Sager, Head of the Department; Bernard J. Babler, Joseph H. Boyer, Thomas H. Brown, Richard L. Carlin, Melvyn R. Churchill, Charles K. Hunt, Jacques Kagan, Chui Fan Lui, Clifford N. Matthews, Robert M. Moriarty, Jan Rocek, Robert I. Walter

Associate Professors: Ronald J. Baumgarten, Richard P. Burns, Eric A. Gislason, David Gorenstein, Cynthia J. Jameson, J. Victor Mansfield, William L. Mock, Samuel Schrage

Assistant Professors: Benedict W. Bangerter, Anthony H. Francis, Wade A. Freeman, Richard Kassner, Florence C. Klee, Leonard Kotin, James N. McElearney, Robert D. Minard, Robert N. Schwartz, John J. Steiner

Work toward the Master of Science, the Doctor of Arts, and the Doctor of Philosophy is offered in inorganic, organic, and physical chemistry.

Admission Requirements

Applicants must have fulfilled the course requirements leading to a bachelor's degree with a major in chemistry and must have a 4.00 grade-point average (A=5.00) in mathematics and science courses. Applicants with lower averages may apply and will be considered individually. Applicants who have majored in fields other than chemistry may be admitted to graduate study in chemistry on an individual basis.

Degree Requirements

Master of Science

Hours: 48 quarter hours, of which 32 must be within the Department of Chemistry. The remaining 16 hours may be selected from the offerings of other departments on the basis of their relevance to a particular area of interest. Course work in other departments will be strongly recommended when it is judged advisable for the student's best professional development. At least 16 quarter hours must be taken at the 400 level, of which 12 must be selected from the course offerings of the Department of Chemistry.

All M.S. candidates are required to participate in undergraduate teaching, which will be assigned in individual cases according to background and interest. A minimum of 16 quarter hours is required.

Thesis: Optional; up to 18 quarter hours of thesis research may be credited, subject to the approval of the department.

Doctor of Arts

Hours: 144 quarter hours, including a required core program of 56 quarter hours, 24 quarter hours of Chemistry 499, 12 quarter hours of physics, biological sciences, or mathematics, and 48 to 52 additional quarter hours of formal course work in chemistry and other natural sciences selected in consultation with the department.

All Doctor of Arts candidates are required to participate in undergraduate teaching at the University for a minimum of 16 quarter hours.

Theses: Candidates must prepare one thesis based on the design and testing of a new educational aid and one based on original research carried out under the direction of a qualified member of the department, both subject to approval by an examining committee.

All candidates must meet the departmental foreign language requirement.

Prospective candidates may obtain detailed information from the Department of Chemistry.

Doctor of Philosophy

In addition to satisfying the general requirements of the Graduate College, students must pass the departmental cumulative examinations. The only courses required of all candidates are Chemistry 404, 405, and 406, which provide a foundation for the areas of specialization. All other formal course work is determined, with the advice of the department, according to its relevance to the student's field of interest.

Thesis: The candidate must prepare a thesis based upon original research carried out under the direction of a qualified member of the department and approved by an examination committee.

The candidate must also meet the department foreign language requirement.

Prospective candiates may obtain detailed information on all requirements by applying to the Department of Chemistry.

Courses for Graduate and Advanced Undergraduate Students

314. INORGANIC CHEMISTRY. 4 HOURS. Lectures and assigned readings on the chemistry of selected elements. Prerequisite: Chem. 340.

315. INORGANIC CHEMISTRY. 4 HOURS. Lectures and assigned readings in structural organic chemistry, inorganic reaction mechanisms and techniques, and the nature of the coordinate bond. Prerequisite: Chem. 342 or the equivalent.

316. INORGANIC CHEMISTRY LABORATORY. 2 HOURS. Synthesis of inorganic compounds illustrating the use of modern preparative techniques. Prerequisite: Credit or registration in Chem. 315.

321. CHEMICAL AND INSTRUMENTAL ANALYSIS I. 5 HOURS. Chemical and instrumental methods of analysis and their application to the quantitative study of chemical reactions. Prerequisites: Chem. 235 and credit or registration in Chem. 343 or the equivalents.

322. CHEMICAL AND INSTRUMENTAL ANALYSIS II. 3 HOURS. Continues Chemistry 321. Prerequisite: Chem. 321.

327. APPLIED ANALYTICAL CHEMISTRY I. 5 HOURS. Same as Criminal Justice 314. Theory and procedures of separation, purification, and identification of components of industrial and forensic interest. Prerequisites: Chem. 121, 235 or CrJ. 211, 313.

328. APPLIED ANALYTICAL CHEMISTRY II. 5 HOURS. Same as Criminal Justice 315. Advanced instrumental analytical procedures applied to substances of industrial and forensic interest. Prerequisite: Chem. 327.

338. SYSTEMATIC IDENTIFICATION OF ORGANIC COMPOUNDS. 3 HOURS. Primarily a laboratory course; chemical, physical, and spectroscopic methods are used to separate, purify, and identify organic compounds. Prerequisite: Chem. 237.

339. ORGANIC SYNTHESIS. 2 TO 4 HOURS. Discussion and laboratory work involving special techniques in organic synthesis. Prerequisite: Chem. 237 or the equivalent.

340. PHYSICAL CHEMISTRY I. 4 HOURS. Credit is not given for both the Chemistry 340, 342, 344 sequence and the 380-382 sequence. Introduction to the study of chemical principles. Prerequisites: Chem. 119 or 121, credit or registration in Math. 133, and one year of college physics.

341. PHYSICAL CHEMISTRY LABORATORY I. 2 HOURS. Quantitative experimental study of chemical principles. Prerequisite: Concurrent registration in Chem. 340.

342. PHYSICAL CHEMISTRY II. 4 HOURS. Continues Chemistry 340. Prerequisite: Chem. 340.

343. PHYSICAL CHEMISTRY LABORATORY II. 3 HOURS. Continues Chemistry 341. Prerequisites: Chem. 341 and concurrent registration in Chem. 342.

344. PHYSICAL CHEMISTRY III. 4 HOURS. Continues Chemistry 342. Prerequisite: Chem. 342.

345. PHYSICAL CHEMISTRY LABORATORY III. 2 HOURS. Continues Chemistry 343. Prerequisites: Chem. 343 and concurrent registration in Chem. 344.

347. INTRODUCTION TO QUANTUM CHEMISTRY. 4 HOURS. Applications of quantum mechanics to problems of chemical interest. Additional assignments are required. Prerequisite: Chem. 344.

348. THERMODYNAMICS. 4 HOURS. Lectures and assigned readings; applications to chemical systems. Prerequisite: Chem. 344.

349. STATISTICAL THERMODYNAMICS. 4 HOURS. Introduction to statistical mechanics and application to equilibrium thermodynamics. Prerequisite: Chem. 344.

350. BIOCHEMISTRY I. 4 HOURS. Same as Biological Sciences 370. Chemistry of biological systems, including proteins and enzymes. Prerequisites: Chem. 119 or 121 and credit or registration in Chem. 235.

351. BIOCHEMISTRY II. 4 HOURS. Same as Biological Sciences 371. Continues Chemistry 350. Carbohydrate and lipide metabolism. Electron transport. Prerequisite: Chem. 350.

352. BIOCHEMISTRY III. 4 HOURS. Same as Biological Sciences 372. Continues Chemistry 351. Metabolism of amino acids, nucleic acids, and proteins; the biosynthesis of biological macromolecules. Prerequisite: Chem. 351.

353. CHEMICAL BIOGENESIS. 4 HOURS. Same as Biological Sciences 353. Biosynthesis of important biological compounds. Prerequisite: Chem. 234.

355. BIOCHEMISTRY LABORATORY I. 2 HOURS. Introduction to experimentation with biochemical systems, processes, and compounds of biochemical importance. Prerequisites: Chem. 121 and registration in Chem. 350.

357. BIOCHEMISTRY LABORATORY II. 2 HOURS. Continues Chemistry 355. Prerequisites: Chem. 355 and registration in Chem. 351.

361. ADVANCED ORGANIC CHEMISTRY I. 4 HOURS. A physical-organic approach to organic reactions with particular emphasis on reaction mechanisms and the relationship between reactivity and structure. Lectures and assigned readings. Prerequisites: Chem. 235 and 344.

362. ADVANCED ORGANIC CHEMISTRY II. 4 HOURS. Continues Chemistry 361. Lectures and assigned readings. Prerequisite: Chem. 361.

380. PRINCIPLES OF PHYSICAL CHEMISTRY I. 3 HOURS. Credit is not given for both the Chemistry 380, 382 sequence and the 340, 342, 344 sequence. Chemistry 380 and 382 provide an elementary introduction to physical chemistry; particular emphasis on topics of importance in the biological and health sciences. Prerequisites: Chem. 119 or 121, calculus, and two quarters of physics.

382. PRINCIPLES OF PHYSICAL CHEMISTRY II. 4 HOURS. Continues Chemistry 380. Prerequisite: Chem. 380.

383. ELEMENTARY PHYSICAL CHEMISTRY LABORATORY. 1 HOUR. An introductory course. Prerequisite: Chem. 380.

384. SURFACE AND MACROMOLECULAR CHEMISTRY. 4 HOURS. Interfacial phenomena, stability of disperse systems, properties of polymer solutions. Prerequisites: Chem. 382 or the equivalent and consent of the instructor.

385. SURFACE AND MACROMOLECULAR LABORATORY. 2 HOURS. Techniques in surface and macromolecular chemistry. Prerequisites: Credit or registration in Chem. 384 and consent of the instructor.

392. INDEPENDENT STUDY. 1 TO 4 HOURS. May be repeated for credit. Individual study, under close supervision of a faculty member, in areas not covered in standard courses. Credit is contingent on the submission of a written report to both the supervisor for approval and the Department of Chemistry for information. A maximum of 8 hours of Chemistry 392 and 399 combined may be credited toward departmental undergraduate-degree course requirements. Prerequisites: Approval of the department and consent of the instructor.

393. TOPICS IN MODERN CHEMISTRY. 2 TO 4 HOURS. Lectures, demonstrations, and discussions in specialized areas of chemistry, including analytical, inorganic, organic, and physical chemistry and biochemistry. Prerequisite: Consent of the instructor.

399.   INDEPENDENT RESEARCH. 3 HOURS OR MORE. May be repeated for credit. Individual research performed under the close supervision of a faculty member. Credit is contingent on the submission of a written report to both the supervisor for approval and the Department of Chemistry for information. A maximum of 8 hours of Chemistry 392 and 399 combined may be credited toward departmental undergraduate-degree course requirements. Prerequisites: Approval of the department and consent of the instructor.

Courses for Graduate Students

404.   QUANTUM MECHANICS. 4 HOURS. Exact solution of the Schrodinger equation for simple systems; variational principle; approximation methods in complex systems; effects of electric and magnetic fields. Required of all Ph.D. students in chemistry.

405.   MOLECULAR SPECTROSCOPY. 4 HOURS. Analysis and interpretation of molecular spectra, including electronic, vibrational, magnetic resonance, and Mossbauer spectra. Required of all Ph.D. students in chemistry.

406.   CHEMICAL APPLICATIONS OF GROUP THEORY. 4 HOURS. Introduction to the use of group-theoretical methods in the analysis of spectroscopic problems; ligand and crystal field theory; molecular orbital calculations. Required of all Ph.D. students in chemistry. Prerequisite: Chem. 405.

410.   CURRENT PROBLEMS IN INORGANIC CHEMISTRY. 2 HOURS. May be repeated for credit. Analysis of fundamental concepts in inorganic chemistry as they appear in a modern research context.

412.   SPECIAL TOPICS IN INORGANIC CHEMISTRY. 2 TO 4 HOURS. Lectures on topics not represented in regularly scheduled courses.

413.   PHYSICAL METHODS OF INORGANIC CHEMISTRY. 4 HOURS. Application of physicochemical methods to problems in inorganic chemistry.

414.   ADVANCED INORGANIC LABORATORY. 2 TO 4 HOURS. Experimental methods in synthesis and study of inorganic compounds.

415.   COMPLEX INORGANIC COMPOUNDS. 4 HOURS. Stereochemistry, reactions, and theory of bonding of coordination compounds.

423.   CATALYSIS IN ENZYMOLOGY. 4 HOURS. Application of physical organic chemistry to the understanding of enzyme action and the mechanisms of biochemical reactions. Prerequisites: Chem. 351 and 362.

425.   BIOENERGETICS. 4 HOURS. Thermodynamic changes associated with the formation of chemical gradients, the transformation of metabolites, oxidation-reduction reactions and the synthesis of macromolecules, including detailed consideration of mechanisms of oxidative and photophosphorylation. Prerequisites: Chem. 344 and 351.

431. LITERATURE SEMINAR IN ORGANIC CHEMISTRY. 1 HOUR. Presentation of student papers on current research topics; preparation and distribution of abstracts. Discussion is an integral part of the course.

432. SPECIAL TOPICS IN ORGANIC CHEMISTRY. 4 HOURS. Discussion of topics of current interest.

433. SPECIAL TOPICS IN REACTION MECHANISMS. 4 HOURS. Theory and techniques in specialized areas in reaction mechanisms. Prerequisite: Chem. 362 or the equivalent.

434. PHYSICAL METHODS IN ORGANIC CHEMISTRY. 4 HOURS. Application of infrared, ultraviolet-visible, magnetic resonance, electron spin resonance, and mass spectrometry and optical rotatory dispersion in organic chemistry. Prerequisite: Chem. 405.

435. ADVANCED ORGANIC SYNTHESIS. 4 HOURS. Discussion and laboratory work involving special techniques in organic synthesis. Prerequisite: Credit or registration in Chem. 434.

436. CHEMISTRY OF NATURAL PRODUCTS. 4 HOURS. Discussion of the more important groups of natural products, including their structure determination, synthesis, and biogenetical relationships. Offered alternate years. Prerequisite: Chem. 235.

437. SURVEY OF ORGANIC CHEMISTRY I. 4 HOURS. Topics on synthesis, mechanisms, and stereochemistry at an advanced level.

438. SURVEY OF ORGANIC CHEMISTRY II. 4 HOURS. Continues Chemistry 437. Prerequisite: Chem. 437.

439. SURVEY OF ORGANIC CHEMISTRY III. 4 HOURS. Continues Chemistry 438. Prerequisite: Chem. 438.

440. CURRENT PROBLEMS IN PHYSICAL CHEMISTRY. 2 HOURS. May be repeated for credit. Analysis of fundamental concepts in physical chemistry as they appear in a modern research context.

442. SPECIAL TOPICS IN PHYSICAL CHEMISTRY. 2 TO 4 HOURS. Lectures and reading in areas not normally treated in standard courses. Discussions of topics of current interest.

443. SPECIAL TOPICS IN CHEMICAL KINETICS. 2 TO 4 HOURS. Theory and techniques in specialized areas of chemical kinetics. Prerequisite: Chem. 349 or the equivalent.

444. STATISTICAL MECHANICS I. 4 HOURS. Statistical models of systems in thermodynamic equilibrium. Offered alternate years. Prerequisite: Chem. 349.

445. STATISTICAL MECHANICS II. 4 HOURS. Statistical models of the liquid state and nonequilibrium processes. Prerequisite. Chem. 444.

446.   QUANTUM CHEMISTRY I. 4 HOURS. Treatment of complex atoms and molecular systems. Hartree-Foch calculations and other methods; interaction of radiation with matter. Prerequisite: Chem. 406.

447.   QUANTUM CHEMISTRY II. 4 HOURS. Continues Chemistry 446. Prerequisite: Chem. 446.

448.   QUANTUM CHEMISTRY III. 4 HOURS. Continues Chemistry 447. Prerequisite: Chem. 447.

461.   SYNTHETIC METHODS OF ORGANIC CHEMISTRY I. 4 HOURS. Discussion of methods used in organic syntheses; introduction and modification of functional groups, methods of selective group protection, stereospecific processes, recent examples of applications. Prerequisite: One year of organic chemistry.

462.   SYNTHETIC METHODS OF ORGANIC CHEMISTRY II. 4 hours. Continues Chemistry 461. Prerequisite: Chem. 461.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Prerequisite: Approval of the department.

CRIMINAL JUSTICE

Professors: James W. Osterburg, Head of the Department; James R. Carey, Hans Mattick, Joseph Nicol

Associate Professors: Bernard Dolnik, Sydney Hyman, Patrick McAnany, Stephen A. Schiller, John A. Webster

Assistant Professors: Sidney F. Bosen, R. Michael Buren, Larry L. Tifft

    The Department of Criminal Justice offers work leading to the Master of Arts in Criminal Justice and the Master of Science in Criminalistics.

Admission Requirements

1.   All applicants must have a baccalaureate from an accredited institution.
2.   Students applying for admission to the Master of Arts in Criminal Justice program should have a strong background in the social sciences (a minimum of 20 quarter hours in advanced courses) and a basic course in statistical methods. Students applying for admission to the Master of Science in Criminalistics program should have a strong background in the natural or physical sciences (a minimum of 20 quarter hours in advanced

courses) and a basic course in statistical methods. Students with other backgrounds may petition for admission. Informational deficiencies, as determined by the department's Committee on Graduate Studies and the student's faculty adviser, must be made up early in the student's residence. No credit toward the degree is given for courses taken to remedy deficiencies.

3. The student's grade-point average must meet the minimum Graduate College requirement for undergraduate work.

4. Applicants must submit Graduate Record Examination scores on the verbal and quantitative aptitude tests. If available, the test related to the undergraduate major must be taken.

5. Three letters of recommendation are required, preferably from professors who are familiar with the student's recent work. If the applicant has been engaged for some time in professional work, letters from supervisors may be substituted.

6. A one-page statement must be submitted describing the applicant's reasons for desiring to take graduate work in criminal justice and the relationship of this work to his professional and other goals.

7. A departmental committee will make all admission decisions for the department.

Degree Requirements for the Master of Arts in Criminal Justice, the Master of Science in Criminalistics

The basic requirements for these degrees are identical except for the type of thesis or internship projects required and the elective and collateral courses recommended to fulfill the goals of the student.

Students must complete a minimum of 48 quarter hours distributed as follows:

1. All students must complete the core curriculum of 20 quarter hours:
   Criminal Justice 400, Systems Concepts, 4 hours
   Criminal Justice 410, Processes and Institutions, 4 hours
   Criminal Justice 470, Law and Its Byways, 4 hours
   Criminal Justice 480, Crime and Social Control, 4 hours
   Criminal Justice 490, Research Methodology, 4 hours

A student with extensive undergraduate work in core areas may, at the discretion of his adviser, substitute other 400-level courses of equal credit in the same substantive areas.

2. The remaining courses consist of electives within criminal justice and in collateral fields. Apportionment between these two will be determined in consultation with the graduate adviser on the basis of previous preparation, student interest, objectives, and program balance.

3. The student may pursue one of three options: thesis, master's paper, or internship.

The three options are not mutually exclusive. A student who elects the *thesis* option or the *master's paper* option may choose to participate in some field internship experience, and similarly, the student who elects the *master's paper* option or the *internship* option may decide to convert his master's paper or internship report into a thesis.

4. A candidate must pass a comprehensive examination, given at least once each quarter, by the end of his third quarter of full-time residence or the equivalent. The examination may be repeated once, within two quarters of full-time residence or the equivalent, if the first attempt is unsuccessful.

The thesis emphasizes research design, the collection and organization of data, and the integration of course material. A thesis is appropriate for the student who is planning a research career or further graduate study. Within the first two quarters of residence, a student who elects this option should submit a thesis proposal for approval by the Department Committee on Graduate Studies. From 12 to 16 quarter hours of credit for thesis research may be allowed toward the degree.

The master's paper option is designed to demonstrate, in a paper of general scope, the student's ability to integrate knowledge in the field of criminal justice. It is appropriate for the student whose career interests lie either in teaching or in administration. From 6 to 10 quarter hours of credit may be allowed toward the degree.

The internship option emphasizes the integration of course materials with learning experiences in a series of field internships among operating criminal justice agencies. It is appropriate for the student who wishes to teach, for the student without experience in criminal justice, or for the student who wishes to broaden the base of his existing knowledge. An internship report is required, which must evaluate critically the internship experiences and demonstrate their integration with several areas of criminal justice. From 4 to 8 quarter hours of credit may be allowed toward the degree.

Courses for Graduate and Advanced Undergraduate Students

313. ADVANCED CRIMINALISTICS ANALYSIS LABORATORY. 5 HOURS. Continues Criminal Justice 211. More advanced concepts of identification and individualization, including the examination of less frequently encountered physical evidence materials, and empirical data requirements for interpretation of examinations. Prerequisites: CrJ. 210 and 211.

314. APPLIED ANALYTICAL CHEMISTRY I. 5 HOURS. Same as Chemistry 327. Theory and procedures of separation, purification, and identification of components of industrial and forensic interest. Prerequisites: Chem. 121, 235 or CrJ. 211, 313.

315.   APPLIED ANALYTICAL CHEMISTRY II. 5 HOURS. Same as Chemistry 328.
        Advanced instrumental analytical procedures applied to substances of industrial
        and forensic interest. Prerequisite: Chem. 327 or CrJ. 314.

330.   COMPLEX ORGANIZATIONS IN THE CRIMINAL JUSTICE SYSTEM. 4
        HOURS. Exploration and analysis. Police departments, courts, and prison
        structure in context and mutual permeability with their environments. Special
        attention to research questions. Prerequisite: Junior standing.

333.   SOCIOLOGY OF LAW. 4 HOURS. Same as Sociology 333. The origin and
        development of legal norms in various social settings; their relationship to custom
        and incorporation in legal and quasi-legal institutions; special attention to the
        difference between legal and sociological reasoning; law as an instrument of social
        change. Prerequisite: 8 hours of upper-division sociology, including Soc. 230 or
        CrJ. 230.

335.   ORGANIZED CRIME IN THE UNITED STATES. 4 HOURS. The development
        of organized crime throughout history; detailed consideration of the political,
        social, and economic conditions involved in the appearance, spread, and
        expansion of organized crime in America. Prerequisites: CrJ. 101, 102, and 230.

339.   INSTITUTIONAL TREATMENT OF OFFENDERS. 4 HOURS. The role of the
        custodial and correctional institutions in the treatment of the offender;
        philosophy of administration and management of institutions; survey of historical
        development and current trends in jails and prisons. Prerequisites: CrJ. 101 and
        102.

340.   CRIMINAL SELF AND CRIMINAL CAREERS. 4 HOURS. The development of
        criminal self-conceptions; social-psychological processes of group alienation;
        development of commitment and professionalization in the development of
        criminal careers. Selected case studies. Prerequisites: Soc. 100 and CrJ. 231.

345.   COMMUNITY TREATMENT OF OFFENDERS. 4 HOURS. The history and
        development of programs relating to community treatment of offenders;
        examination of the philosophies and programs dealing with the rehabilitation and
        reintegration of the offender into society. Prerequisites: CrJ. 101 and 102; Soc.
        225 and 276.

350.   THE ROLE OF LAW ENFORCEMENT IN COMMUNITY RELATIONS. 4
        HOURS. Analysis of the relationship between law enforcement and the social
        structure of the community, including an examination of the significant problem
        areas involving minority elements, cultural and ethnic groups, power and
        social-elite, and political and social-action movements. Prerequisites: CrJ. 101,
        102, Soc. 225 or 276.

351.   CRIMINAL LAW I: SUBSTANTIVE CRIMINAL LAW. 4 HOURS. Required in
        the curriculum in criminal justice; cannot be substituted for a criminal law course
        taken by law students. General doctrines of criminal liability in the United States;
        classification of crimes as against persons, property, and the public welfare.

Emphasis on the concept of governmental sanctions of the conduct of the individual. Prerequisites: CrJ. 101 and 102.

352. CRIMINAL LAW II: CRIMINAL PROCEDURE. 4 HOURS. Required in the criminal justice curriculum; cannot be substituted for a criminal law course taken by law students. The criminal process. Legal problems associated with the investigation of crime, the acquisition of evidence, the commencement of a criminal proceeding, the prosecution and defense of charges, sentencing, and appeal. Principal concern is with the development of existing procedures and examination of current efforts for reform. Prerequisite: CrJ. 351.

353. CRIMINAL LAW III: THE INSTRUMENTALITIES OF CRIMINAL JUSTICE. 4 HOURS. Continues Criminal Justice 352. Examination of the agencies which play significant roles in the criminal process. Functions of the law enforcement agency, counsel, and the courts. Particular emphasis on the responsibilities and interrelationships of the agencies examined. Prerequisite: CrJ. 352.

354. EVIDENCE. 4 HOURS. Rules of evidence as they apply to judicial proceedings and administrative hearings relative to the criminal process. Development of the underlying rationale of the rules. Emphasis on the relationship between methods of evidence collection and admissibility. Prerequisite: CrJ. 352.

360. INDUSTRIAL AND COMMERCIAL SECURITY ADMINISTRATION. 4 HOURS. Theories and philosophy of the administration of industrial and commercial security functions; survey of contemporary organization and management of security operations; application of law enforcement principles within private enterprise. Prerequisites: CrJ. 103, 258, and 259.

391. PROSEMINAR IN CRIMINAL JUSTICE. 4 HOURS. Study in depth of current issues, problems, and developments of serious concern within the field of the administration of criminal justice. Prerequisites: CrJ. 101, 102 and junior standing.

398. THE PROBLEM OF JUSTICE. 4 HOURS. Same as Political Science 398 and Religious Studies 398. The premodern view of justice, such as Plato's or Aristotle's; the modern understanding of justice, such as Hobbes' or Locke's, which is the foundation of the modern political regime; Rousseau's seminal political thought on justice which is the basis of a variety of reforms and alternatives offered to Hobbes' and/or Locke's political regime. Prerequisite: Two courses in political science, including PolS. 150 or 151.

399. INDEPENDENT STUDY. 2 TO 8 HOURS. For criminal justice majors only. Independent study and research, under the direct supervision of a faculty member, on a subject or subjects not covered in the regular curriculum. Prerequisites: Consent of the instructor, obtained by preregistration in the department office; at least five criminal justice courses, including CrJ. 101, 102, 205, and 206.

Courses for Graduate Students

400. SYSTEMS CONCEPTS: INTERACTION AND CHANGE. 4 HOURS. Analysis of
     the criminal justice system as a system. Interorganization structure, the
     interaction of component parts, organizational analysis, problem formulation,
     analytic systems methodology, and planned organizational and systems change
     and their consequences are analyzed.

408, STRATEGIES OF CHANGE AND INNOVATION. 4 HOURS. Analysis of change
     and innovation in the criminal justice system from both historical and
     contemporary perspectives, characteristics of successes and failures in innovation.
     Examination of programs and goals. Problems and techniques in the evaluation of
     change.

409. PLANNED CHANGE IN CRIMINAL JUSTICE ORGANIZATIONS. 4 HOURS.
     General review of the notion and theories of planned change on the individual,
     organizational, and community levels. In-depth analysis of the methods and
     strategies of change, especially as they have application for the organizations of
     the criminal justice system. Prerequisite: CrJ. 410.

410. CRIMINAL JUSTICE: PROCESS AND INSTITUTIONS. 4 HOURS. Critical
     examination of the criminal justice system. The dynamics and processes of
     contemporary police, judicial, and correctional institutions are evaluated in the
     context of key historical developments and relevant research.

418. TEACHING CRIMINAL JUSTICE. 4 HOURS. Development of the ability to
     recognize the relationships between the three elements of effective teaching:
     learning objectives; teaching strategy; evaluation procedures found in the field of
     criminal justice.

440. CORRECTIONS AND THE CRIMINAL JUSTICE SYSTEM. 4 HOURS.
     Theoretical and historical consideration of prison confinement and the various
     societal alternatives studied in the framework of the overall criminal justice
     system. Historical review of the gaps between conceptual designs and practices.
     Prerequisite: CrJ. 410.

449. LEGAL LIMITS AND THE CORRECTIONAL PROCESS. 4 HOURS. The legal
     structure of the post-adjudicatory criminal justice system. Examination of the
     major sentencing alternatives and their implications in terms of effectiveness and
     human rights. Prerequisites: CrJ. 470 and concurrent registration in CrJ. 440.

460. FORENSIC SCIENCE LABORATORY I. 4 HOURS. Theory and analysis of
     criminalistic problems in opinion evidence through examination of materials
     related to individualization. Methods may include physical and chemical
     procedures for evaluation, comparison, and particularization. Prerequisite: CrJ.
     313.

461. FORENSIC SCIENCE LABORATORY II. 4 HOURS. Advanced instrumental
     analysis as applied to criminalistics. Simulated crime science evidence is evaluated
     and alternate instrumental methods are compared. Prerequisite: CrJ. 460.

464.   SPECIAL TOPICS IN FORENSIC SCIENCE. 2 TO 4 HOURS. Philosophic, moral, and managerial problems associated with forensic science. Quality control of analytical results; human organ transplants and time of death; product liability and physical evidence; changing views of psychiatry, mental health, crime, and control. Prerequisites: CrJ. 460, 470.

466.   SEMINAR ON RECENT ADVANCES IN FORENSIC SCIENCES. 2 TO 4 HOURS. Discussion of emerging theories and methods and their application. Subjects may include the role of automated analysis, advances in serology, problems of proof and probability theory, detection methods, systems procedures applied to forensic sciences problems. Prerequisite: CrJ. 315.

470.   LAW AND ITS BYWAYS. 4 HOURS. An overview of laws and law systems that produce definitions of politically cognizable deviance and procedures for the application of definitions in particular cases. Emphasis on the social dynamics that produce laws and law ways. Examination of the impact that implementing institutions can have on the interpretation of laws and on future formulations.

478.   DISCRETIONARY JUSTICE. 4 HOURS. The relationship between rules of law and discretionary justice in all components of the criminal justice system. The consequences flowing either from an extravagant insistance on the letter of the law or from an excessive reliance on discretionary power. Methods for confining, structuring, and checking the uses of discretionary power. Prerequisite: CrJ. 470.

480.   CRIME AND SOCIAL CONTROL. 4 HOURS. Analysis of the social context of crime and delinquency causation and definition. Attention to the difference between criminal and noncriminal deviance, the function of legal and quasi-legal norms in various social settings, and theories of crime causation.

489.   CRITICAL CRIMINOLOGY. 4 HOURS. Comparison of one of the better, comprehensive descriptions of the criminal justice system with a series of recent critical works that offer alternative conceptions of the system. Examination of the assumptions, arguments, supporting data, and differing conclusions of these alternative presentations and evaluation of their adequacy and congruence with experience. Prerequisite: CrJ. 480.

490.   RESEARCH METHODOLOGY. 4 HOURS. Provides a foundation for subsequent training in more specialized research methods used by social and behavioral scientists. General consideration of research problems and methods; emphasis on systematic research procedures.

496.   INTERNSHIP IN TEACHING CRIMINAL JUSTICE. 4 HOURS. Teaching criminal justice courses under the supervision of a faculty member. Prerequisite: CrJ. 418.

497.   MASTER'S PAPER RESEARCH. 6 TO 10 HOURS. May be repeated for up to a total of 10 hours; a minimum of 6 hours is required. Students doing research or writing a master's paper register for credit under this number. Prerequisite: Consent of the instructor.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for up to a total of 16 hours; a minimum of 12 hours is required. Students doing thesis research or writing a thesis register for credit under this number. Prerequisites: Consent of the student's adviser; acceptance of the thesis topic and preliminary thesis outline by the thesis committee.

ECONOMICS

Professors: William Grampp, Richard F. Kosobud, George Rosen, William Tongue

Associate Professors: Eliezer B. Ayal, Bert E. Elwert, Allen Sinai

Assistant Professors: Robert D. Auerbach, Donald E. Baer, Frances Flanagan, Kurt F. Hausafus, Mildred Levy, John McDonald, Sol Shalit, Houston Stokes

The department offers a program leading to the Master of Arts in Urban and Quantitative Economics.

Admission Requirements

An undergraduate degree in economics is desirable, but not required, for admission to the graduate program. Students with excellent academic records in other disciplines are encouraged to apply. However, the following courses are required of all students, regardless of their undergraduate major:

Courses in mathematics equivalent to Mathematics 104, 110, 111, 112 at this University (such as mathematics through introductory calculus).

Courses in statistics equivalent to Quantitative Methods 270, 271, 272 (statistics through regression analysis) in the College of Business Administration at this University.

One course in intermediate microeconomic theory and one course in macroeconomic theory.

Any deficiency in the above courses must be made up within the first three quarters. The student is expected to have an undergraduate grade-point average of 4.00 (B). Students with a lower grade-point average will be considered on an individual basis. The student is expected to take the Graduate Record Examination and the sections in economics. Although a minimum score is not required, the faculty will look favorably on scores at or above the 70th percentile.

Degree Requirements

In addition to the general requirements of the Graduate College, the requirements for the M.A. in economics include the following:

Hours: 48 quarter hours of satisfactory course work with a minimum of 40 hours in economics of which at least 20 must be on the 400 level.

Thesis: Students may elect to write an M.A. thesis, for which they will receive up to 12 hours of credit. Credit hours for the thesis may *not* be included among the 20 required 400-level hours in economics. The thesis may be original research or a thorough review of a topic based on secondary sources. In either case, competence in the use of economic analysis as well as in the interpretation of results or conclusions is expected of the candidate. The program of students who do not write a thesis must include 4 hours of independent study (Economics 497) or an approved internship program.

Upon admission each student will develop an M.A. study plan, in collaboration with his graduate adviser, that will comprise his course of study during his enrollment.

The following core of required courses provides the student with a body of knowledge and a grasp of economic methodology that is a base for specialization:

Economics 401, Microeconomics I — 4 hours
Economics 411, Macroeconomics I — 4 hours
Economics 402, Microeconomics II *or*
Economics 412, Macroeconomics II — 4 hours
Economics 345, Advanced Economic Statistics — 4 hours

The Department of Economics faculty strongly recommends that the student take Economics 336, Introduction to Mathematical Economics, or the equivalent.

The student must successfully pass a comprehensive written examination based on three core courses in theory. This examination will include one part on Microeconomics I, one part on Macroeconomics I, and one part on either Microeconomics II or Macroeconomics II. This comprehensive examination is distinct from the examinations that are given during the courses.

Courses for Graduate and Advanced Undergraduate Students

318.   ECONOMICS OF DECISION MAKING IN THE FIRM. 4 HOURS. Students may not receive credit for both Economics 318 and 321. Theory and application of

the marginalist approach to decision, including treatment of rational decision making under linear constraints. Prerequisites: Econ. 121, Math. 112 or the equivalents.

319. APPLIED PUBLIC ADMINSTRATION ECONOMICS. 4 HOURS. Principles underlying optimal policy-making in government. Analysis of macroeconomic policy; emphasis on the problem of conflicts among policy goals and techniques and use of forecasts. Evaluation of government resource allocation policy, including cost-benefit analysis. Prerequisite: Econ. 318.

320. MACROECONOMIC THEORY. 4 HOURS. Principles of national income accounting, determination of aggregate income and employment, the monetary system in relation to income and employment, short-term income fluctuations, long-term income growth. Prerequisite: Econ. 121.

321. MICROECONOMIC THEORY. 4 HOURS. Operation of individual markets; market structure; theory of the firm; theory of production; demand theory; general equilibrium and welfare economics. Prerequisite: Econ. 121.

322. MANAGERIAL ECONOMICS. 4 HOURS. Application of economic theory to decision making in the business firm. Demand and cost analysis including demand forecasts; price policy of the individual firm; capital budgeting; production analysis; uses of operations research methods. Prerequisite: Econ. 321.

323. BUSINESS CONDITIONS ANALYSIS. 4 HOURS. Application of economic theory to analysis of changes in aggregate income and employment; quantitative economic models and their uses in the prediction of aggregate and more refined levels of business activity. Prerequisite: Econ. 320.

324. ECONOMIC HISTORY OF THE UNITED STATES. 4 HOURS. Growth of the American economy from colonial times to the present; special emphasis on the forces and factors contributing to this process. Prerequisites: Econ. 121 and 8 hours of social sciences.

325. ECONOMIC HISTORY OF EUROPE. 4 HOURS. Evolution of the economic institutions of Europe, beginning with the origins of capitalism; the development of industry, commerce, transportation, finance, and labor. Prerequisites: Econ. 121 and 8 hours of social sciences.

326. HISTORY OF ECONOMIC THOUGHT I. 4 HOURS. Examination of the evolution of positive and normative economics from the sixteenth to the nineteenth century. Prerequisites: Econ. 121 and 9 hours of social sciences.

327. COMPARATIVE ECONOMIC SYSTEMS. 4 HOURS. Description and analysis of the normative and positive characteristics of capitalism, facism, democratic socialism, and communism. Prerequisites: Econ. 121 and 8 hours of social sciences.

328. GOVERNMENT FINANCE. 4 HOURS. Government finance at the federal, state, and local levels, including government expenditures; principles of taxation; fiscal

policy; government borrowing and the national debt; intergovernmental fiscal relations. Prerequisite: Econ. 321.

329. INDUSTRIAL ORGANIZATION. 4 HOURS. The structure of markets; behavior of firms within the market environment; measures of industrial concentration; economics of scale; mergers and the merger movement; price discrimination and tie-in sales; monopoly and cartel arrangements; resale price maintenance; innovation and technological change. Prerequisite: Econ. 321.

330. GOVERNMENT AND BUSINESS. 4 HOURS. The rationale and the mechanisms of the social control of business; the effects of government action in influencing the behavior of business firms; the procompetitive policy embodied in the Sherman Act and related legislation. Prerequisite: Econ. 321.

331. LABOR ECONOMICS. 4 HOURS. Economic problems and issues of trade union organization and wage theory; job security, hours, working conditions, labor legislation, unemployment. Prerequisite: Econ. 320 or 321.

332. URBAN ECONOMICS. 4 HOURS. Survey of economic problems of cities; the nature and function of cities; the demand for and supply of housing and urban land; the implications of location theory for the spatial pattern of cities; the impact of government programs. Prerequisites: Econ. 121 and 8 hours of social sciences.

333. INTERNATIONAL ECONOMICS. 4 HOURS. The balance of payments; fixed, flexible, and multiple exchange rates; the forward exchange market; the international trade multiplier; the transfer problem; capital flows; the law of comparative advantage; the gains from trade; tariffs and subsidies; the factor price equalization theorem; international economic communities. Prerequisite: Econ. 320 or 321.

334. ECONOMIC DEVELOPMENT. 4 HOURS. Same as Latin American Studies 334. Basic problems and characteristics of underdeveloped countries; classical, neoclassical, and modern contributions to the theory of development; major proposals for accelerating development; basic approaches to economic development; laissez-faire, interventionism; role and methods of planning; foreign aid; and economic integration. Prerequisite: Econ. 320 or 321.

335. ECONOMETRICS. 4 HOURS. Specification of economic models; measurement of variables; estimation of economic relationships and testing of economic hypotheses; single equation problems in estimation; introduction to simultaneous equation estimation. Prerequisites: Econ. 320 and 321.

336. INTRODUCTION TO MATHEMATICAL ECONOMICS. 4 HOURS. Application of mathematics to theories of consumer and producer behavior, to the determination of prices in markets, and to growth and stability features of macroeconomic models. Prerequisites: Econ. 320, 321; Math. 110, 112.

342. REGIONAL ECONOMICS. 4 HOURS. Theory of location of economic activity, land use patterns, systems of cities, the spatial pattern of city regions, regional

growth dynamics, interregional transactions analysis, spatial mobility of factors, regional income differences, regional welfare and policy. Prerequisites: Econ. 320, 321.

345.   ADVANCED ECONOMIC STATISTICS. 4 HOURS. Probability, hypothesis testing, and estimation, with emphasis on economic applications; econometric models, multiple linear regression, and introduction to problems of estimation. Prerequisites: Math. 370 and 372 or QM 272.

390.   SPECIAL TOPICS IN ECONOMICS. 4 HOURS. Exploration of an area not covered in existing course offerings, or study in greater depth, or at a more advanced level, of a problem or subject that is covered in an existing course. Subject matter, and sometimes the prerequisites, will vary from quarter to quarter; prior to registration students should consult the department secretary for further information. Prerequisites: Senior standing and 15 hours of 300-level economics courses.

399.   INDEPENDENT STUDY IN ECONOMICS. 2 TO 5 HOURS. May be repeated once for credit. For students who wish to do independent study in an area not covered by existing course offerings, or to explore in greater depth a problem or subject covered in a previously taken course. Prerequisites: 15 hours of 300-level economics courses and consent of both a faculty member and the head of the department.

Courses for Graduate Students

400.   MANAGERIAL ECONOMICS. 4 HOURS. Economic analysis applied to business operations; theory of production and cost analysis; capital theory; pricing of products and factors. Prerequisites: Econ. 320, 321, Fin. 341.

401.   MICROECONOMICS I. 4 HOURS. Theories of consumer and producer behavior and determination of market price. Systematic treatment of the core of microeconomic theory. Prerequisite: Econ. 321.

402.   MICROECONOMICS II. 4 HOURS. Axiomatic approach to the theory of exchange; general equilibrium analysis; welfare economics; capital theory. Prerequisite: Econ. 401.

411.   MACROECONOMICS I. 4 HOURS. Static and dynamic theories of income and employment; advanced treatment of consumption and investment functions; aggregate production functions; trade cycle and growth; stabilization theory and policy. Prerequisite: Econ. 320.

412.   MACROECONOMICS II. 4 HOURS. Survey of recent research on the determination of employment, the price level, growth rates, and balance of payments variables; current theoretical approaches to these problems; policy proposals. Prerequisite: Econ. 411.

426.   HISTORY OF ECONOMIC THOUGHT II. 4 HOURS. Examination of economic ideas from the period of mercantilism to the Lausanne school, including

physiocracy, classical and neoclassical economics, marginal analysis, and Marxism. Prerequisite: Econ. 326.

435.   **ADVANCED ECONOMETRICS. 4 HOURS.** Detailed treatment of simultaneous equation estimation; evaluation of alternative estimators; problems in estimation; survey of selected large-scale econometric models. Prerequisite: Econ. 345.

436.   **ADVANCED MATHEMATICAL ECONOMICS. 4 HOURS.** Illustrations of applications of the calculus and linear algebra to elementary theories of consumer and producer behavior and to price formation in markets. Applications in macroeconomics. Prerequisite: Math. 131 or the equivalent.

471.   **ADVANCED URBAN ECONOMICS. 4 HOURS.** Analysis in depth of the major topics in the field of urban economics. Students may be required to prepare a research paper. Prerequisite: Econ. 332 or the equivalent.

497.   **INDEPENDENT STUDY IN ECONOMICS. 4 HOURS.** Independent study under the direction of a faculty member. Prerequisite: Consent of the instructor.

498.   **WORKSHOP IN ECONOMICS. 4 HOURS.** A workshop seminar; students and faculty present the results of their research on any special topic in economics. Each participant is required to research a topic or problem and present an acceptable paper on his method and results. Participants criticize and evaluate the materials presented. Prerequisite: Econ. 401 or 411.

499.   **THESIS RESEARCH. 0 TO 16 HOURS.** May be repeated for credit. Students present the results of their thesis research. Prerequisite: Approval of thesis prospectus by the thesis committee.

ENERGY ENGINEERING

Professors: James P. Hartnett, Head of the Department; Paul M. Chung, John H. Kiefer, Irving F. Miller, Satish S. Saxena, Harold A. Simon

Associate Professors: Lyndon R. Babcock, Jr., Joseph C.F. Chow, Allen C. Cogley, David S. Hacker, Ali G. Mansoori, Wolodymyr J. Minkowycz, Edward S. Pierson, Stephen Szepe

Assistant Professors: John C. Cutting, Edward J. Schlossmacher, Kenneth L. Uherka, Calvin J. Wolf

The department offers a program leading to the Master of Science in Energy Engineering and, jointly with the Department of Materials Engineering, a program leading to the Doctor of Philosophy in Engineering (Solids and Fluids).

These programs are broadly based to accommodate students in aerospace,

chemical, mechanical, and power engineering and in related fields. The primary areas upon which these fields are based are continuum and molecular fluid mechanics, heat and mass transfer, and macroscopic and microscopic thermodynamics.

After the student is admitted to the Graduate College, he is assigned a temporary adviser; he is required to choose a permanent adviser during the first year. As soon as the permanent adviser has been selected, the student must outline the complete program he proposes for the degree (M.S. or Ph.D.) in consultation with his adviser and the graduate committee of the department.

The Ph.D. program includes the following broad areas of specialization: continuum mechanics, environmental engineering, fluid mechanics, gas dynamics, heat transfer, metallurgy, plasma dynamics, soil engineering, chemical engineering, and structures. Of these, the Department of Energy Engineering offers study in the fields of chemical engineering, environmental engineering, fluid mechanics, gas dynamics, and heat transfer. Students are permitted and encouraged to follow interdisciplinary programs that may include more than one area of specialization and may require enrollment in courses in more than one department.

Admission Requirements

Graduates from recognized engineering colleges will be admitted if they have maintained a grade-point average of B (4.00 out of 5.00) or better in undergraduate study. Those with lower averages may be admitted upon recommendation of the department, provided they satisfy the minimum requirements of the Graduate College. Practicing engineers who wish to return for further graduate instruction may be admitted tentatively if their professional experience indicates that they will be able to follow the program successfully. Tentative admission will become permanent after the completion of at least 16 quarter hours with an average of 4.00 or better.

Degree Requirements

A grade-point average of at least 4.00 is required. Credit toward a graduate degree is not given for any course in which a grade of less than C has been obtained.

Master of Science

For the degree, 48 quarter hours are required, at least 16 of which must be in 400-level courses. A student may or may not submit a thesis; if he does so, 16 hours of Energy Engineering 499, Thesis Research, will be credited

toward the degree. If he does not present a thesis, he must complete a research project under the guidance of a department adviser. This project requires a report that demonstrates to the adviser's satisfaction the ability of the student to conduct research at the master's level. Upon completion of this project 4 hours of credit will be awarded. If the candidate submits a thesis, he is exempt from the project, but he must, at the completion of the thesis, defend it before an examining committee.

Doctor of Philosophy

All students who plan to study for the Ph.D. are required to pass one out of a maximum of two written cumulative examinations, which will be offered twice each year. This requirement must be satisfied within the first year if the student enters with a master's degree and within one year after the completion of 48 credit hours of graduate study if he enters with a bachelor's degree.

For the Ph.D. a minimum of 96 hours of course work beyond the bachelor's degree is required, of which at least 32 hours must consist of 400-level courses. The total must include a major, the scope of which is to be determined by the adviser and the graduate committee of the department, and a minor of at least 24 quarter hours. Credit in two courses from the Department of Materials Engineering and at least 12 quarter hours in courses offered by the Department of Mathematics, of which at least three hours must be at the 400 level, are required.

A major requirement of the Ph.D. program is the completion of a thesis based on original research carried out under the supervision of the student's adviser. The thesis, also written under the supervision of the adviser, must be defended before an examining committee.

Courses for Graduate and Advanced Undergraduate Students

304.   TRANSPORT PHENOMENA. 4 HOURS. Introduction to continuum theory of momentum, energy, and mass transfer. Transport of scalar and vector quantities. Reynolds' transport theorem. General differential equations of transport phenomena. Momentum shell balances. Energy transport. Diffusion. Couple operations: free convection, simultaneous heat and mass transfer. Prerequisites: EnrE. 201 and 211.

305.   STATISTICAL THERMODYNAMICS. 4 HOURS. Microscopic statistical approach to thermodynamic properties. Calculation of partition function and thermodynamic properties. Poloyatomic systems; chemical equilibrium; other engineering applications. Prerequisites: EnrE. 201; Math. 220 or the equivalent.

307.   KINETIC THEORY OF GASES AND TRANSPORT PHENOMENA. 4 HOURS. Basic concepts of kinetic theory of gases. Equations of state and their molecular interpretation. Elementary classical statistics, molecular collisions. Application of

the kinetic theory to viscosity, heat conduction, and diffusion. Prerequisite: Completion of the core program.

311. OCEAN AND ESTUARY HYDRODYNAMICS. 4 HOURS. Fluid mechanics of oceans, estuaries, coastlines, and lakes. Tidal, current, and wave phenomena of large, free-surface bodies of water in rotating coordinates. Laboratory work with rotating water table and wave generation and measurements. Prerequisite: EnrE. 214.

312. POROUS MEDIA. 4 HOURS. Mechanics of fluid flow in porous media. Steady and unsteady laminar flow in isotropic and anisotropic media. Multiphase and multilayered systems. Prerequisites: EnrE. 212 and 215.

313. FLIGHT DYNAMICS: STABILITY AND CONTROL. 4 HOURS. Static and dynamic stability and control of six-degree-of-freedom machines with aerodynamic and propulsive loading. Development of the complete force, moment, orientation, and control equations. Laboratory in aerodynamic force measurements and analog simulation of stability and control. Prerequisite: EnrE. 212.

314. PROPULSION. 4 HOURS. Thermodynamics and fluid mechanics of air breathing engines. Performance of rockets—chemical, nuclear, and electrical. Prerequisite: EnrE. 213.

316. INTRODUCTION TO CONTINUUM MECHANICS. 4 HOURS. Same as Materials Engineering 316. Cartesian tensors, kinematics of fluids and solids, conservation equations, constitutive equations for simple materials. Examples. Prerequisites: EnrE. 211 or MatE. 214, and Math. 220.

317. INTERMEDIATE FLUID MECHANICS. 4 HOURS. Development of the conservation equations for a Newtonian fluid: continuity, Navier-Stokes, and energy equations. Some exact and approximate solutions of highly viscous, viscous, and inviscid flow problems. Prerequisite: Math. 220 or the equivalent.

321. INTERMEDIATE HEAT TRANSFER. 4 HOURS. Topics in conduction, convection, and radiation with emphasis on exact solutions; extended surfaces, two-phase flow, entrance length problems, real surface and gaseous radiation problems, and combined modes of heat transfer. Laboratory to complement the lectures. Prerequisite: EnrE. 221.

325. COMBUSTION ENGINEERING. 4 HOURS. Topics in combustion, providing both a theoretical and applied understanding of flame processes as they relate to furnace design, air pollution, and propulsion. Heat and mass transfer by various modes, chemistry and dynamics of combustion phenomena. The course will relate to material found in current literature. Prerequisites: EnrE. 201 and either 214 or 234.

331. CHEMICAL ENGINEERING THERMODYNAMICS. 4 HOURS. Review of first and second laws with subsequent applications to chemical systems. Free energy,

availability, equilibrium conditions, and applications to chemical processes. Equilibrium constant, chemical potential for gas reactions, heterogeneous systems, and phase change. Prerequisite: EnrE. 201 or the equivalent.

335. PHYSICAL PROPERTIES OF FLUIDS. 4 HOURS. Prediction and correlation of the various equilibrium and nonequilibrium properties of pure fluids and their mixtures, such as critical constants, vapor pressure, latent heat of vaporization, heat capacity, heat of formation, surface tension, virial coefficients, viscosity, thermal conductivity, and diffusion coefficients. Prerequisites: EnrE. 201 and 211.

341. EXPERIMENTAL METHODS AND TECHNIQUES. 4 HOURS. Purpose and design of experiments; statistical analysis of errors; wind tunnel, shock tube, high vacuum and chemical reactor techniques; theory of mechanical, thermal, optical, and chemical measurements.

351. ELECTROMECHANICAL ENERGY CONVERSION I. 4 HOURS. Conservation of energy and electromagnetic forces. Principles of rotating machines and equations of motion. Applications to synchronous, induction, dc, and novel machines. Linear and nonlinear lumped-parameter systems, stability. Laboratories. Prerequisites: InfE. 212 and 219.

352. ELECTROMECHANICAL ENERGY CONVERSION II. 4 HOURS. Continues Energy Engineering 351. Completion of rotating machines and lumped-parameter systems. Interaction of electromagnetic fields with stationary and moving continuous media, Maxwell stress tensor, waves and instabilities. Applications to energy conversion with emphasis on fluids (magnetohydrodynamics). Laboratories. Prerequisites: EnrE. 211, 351, and InfE. 221.

353. DIRECT ENERGY CONVERSION. 4 HOURS. Novel methods of converting heat directly to electrical energy. Topics are chosen from among, but not limited to, magnetohydrodynamics, thermoelectrics, thermionics, and fuel cells. Prerequisites: EnrE. 211 and 351.

361. ATMOSPHERIC MOTIONS. 4 HOURS. The equations of motion on a rotating earth and their application to meteorology. Various aspects of inertial, geostrophic, and gradient winds. Atmospheric turbulence and flow in the earth's boundary layer. Laboratory modeling criteria and dynamic similitude. Diffusion of heat, water vapor, and atmospheric pollutants. Prerequisite: EnrE. 214.

372. WATER RESOURCES AND POLLUTION CONTROL. 4 HOURS. Hydraulics of water supply and distribution systems. Water quality tests for biological and chemical pollutants. Basic principles and theory of water purification and sanitary engineering, including physical, chemical, and biological treatment processes. Advanced water reclamation techniques. Prerequisites: Chem. 121, EnrE. 261.

391. SEMINAR. 1 TO 4 HOURS. May be repeated for additional credit. Topics to be arranged. Prerequisite: Consent of the instructor.

396. SENIOR DESIGN I. 4 HOURS. Same as Information Engineering 396, Materials Engineering 396, and Systems Engineering 396. Introduction to engineering

economics, legal and social constraints on design, safety and reliability theory, and the use of simulation and optimization techniques in the engineering design process. Prerequisite: Senior standing in the College of Engineering.

397.   SENIOR DESIGN II. 4 HOURS. Same as Information Engineering 397, Materials Engineering 397, and Systems Engineering 397. Application of principles of engineering and engineering design methodology to the solution of a large-scale design problem. May be taken in any department, regardless of area of concentration. Prerequisite: EnrE. 396.

Courses for Graduate Students

401.   ADVANCED THERMODYNAMICS. 4 HOURS. The laws of thermodynamics. General conditions for equilibrium and stability. Thermodynamic potentials. Phase transition and critical phenomena. Systems in electric, magnetic, gravitational, and centrifugal fields. Principles of irreversible thermodynamics. Onsager's fundamental theorem. Engineering applications. Prerequisites: EnrE. 202 and Math 220 or the equivalents.

402.   FLUID-PHASE EQUILIBRIA. 3 HOURS. Application of the laws of thermodynamics to fluid-phase equilibria systems. Concepts of chemical potential, fugacity, and activity. Application of phase rule to multicomponent fluids. Latent heat and vapor pressures. Consistency tests. Engineering applications. Prerequisite: EnrE. 331.

403.   THERMODYNAMICS OF MULTICOMPONENT SYSTEMS. 3 HOURS. Application of thermodynamics to chemical engineering systems. Laws of corresponding states and conformal solution theories. Dilute, ideal, near-ideal, and nonideal solutions. Molecular considerations and their use for prediction and correlation of data. Prerequisite: EnrE. 402 or the equivalent.

404.   IRREVERSIBLE THERMODYNAMICS. 4 HOURS. Irreversible systems approaching equilibrium. Method of irreversible thermodynamics; Onsager's fundamental theorem; statistical and kinetic bases of the theorem. Engineering applications: chemical and electrochemical reactions; thermal diffusion and diffusion thermophenomena; thermoelectric and thermomagnetic phenomena. Thermodynamic time. Prerequisite: EnrE. 401 or the equivalent.

405.   ADVANCED STATISTICAL THERMODYNAMICS. 4 HOURS. Electromagnetic radiation, quantum mechanics of solids, diatomic and polyatomic gases, statistical mechanics of interacting particles, real gases and liquids, chemical equilibrium and irreversible processes; emphasis on the engineering applications. Prerequisite: EnrE. 305.

406.   ADVANCED TRANSPORT PHENOMENA. 4 HOURS. Development of the concepts of momentum, heat, and mass transfer by molecular motion, in laminar flow, and in arbitrary continuums. Interphase transport and transport in turbulent flow. Transport by radiation and transport in large flow systems. Prerequisite: EnrE. 304 or the equivalent.

407. KINETIC THEORY OF NONUNIFORM GASES I. 4 HOURS. Distribution function: Boltzmann equation and its solution, two-particle collisions, inverse collisions, collision cross-sections, intermolecular forces, derivation of transport coefficients of gases, and thermal diffusion. Prerequisites: EnrE. 307 and Math. 322.

412. POTENTIAL FLOW. 4 HOURS. Fluid kinematics, fundamental equations, exact and approximate solutions of the potential equation, conformal mapping, airfoil theory, and surface waves. Prerequisite: EnrE. 212 or the equivalent.

414. MECHANICS OF VISCOUS FLUIDS. 4 HOURS. Internal and external flows. Boundary layer analysis. Similarity solutions, integral methods, and other techniques for treating laminar and turbulent flows. Prerequisite: EnrE. 310 or the equivalent.

416. COMPRESSIBLE FLUID MECHANICS. 4 HOURS. Conservation equations, equations of state, surface of discontinuity, one-dimensional and two-dimensional subsonic and supersonic flows, Prandtl-Mayer expansions and shock phenomena, theory of characteristics, and hodograph methods. Prerequisite: EnrE. 213 or the equivalent.

418. FUNDAMENTALS OF TURBULENCE. 4 HOURS. Mathematical descriptions of turbulence field; kinematics of homogeneous turbulence; correlation and spectrum tensors; dynamics behavior of isotropic turbulence; universal equilibrium theory; nonisotropic turbulence; transport processes in turbulent flows. Prerequisites: EnrE. 414 or 422 and Math. 323 or the equivalent.

419. NONLINEAR CONTINUUM MECHANICS I. 4 HOURS. Same as Materials Engineering 419. Kinematics and fundamental laws of mechanics. General constitutive equations; reduced constitutive equations. Homogeneous motions of simple bodies. Isotropic group, simple fluids, simple solids, simple subfluids. Examples. Prerequisite: EnrE. 316.

420. NONLINEAR CONTINUUM MECHANICS II. 4 HOURS. Same as Materials Engineering 420. Special classes of materials. Simple fluids, viscometric flows, the Weissenberg effect. Isotropic elastic materials, exact solutions. Wave propagation. Thermodynamics. Nonlinear viscoelastic materials, polar materials, and other materials. Prerequisite: EnrE. 419.

421. HEAT CONDUCTION. 4 HOURS. Analysis of heat conduction in solids, including the use of Fourier series, integral transforms, similarity transformations, and approximate methods. Prerequisite: Consent of the instructor.

422. CONVECTIVE HEAT TRANSFER. 4 HOURS. Conservation equations. Momentum, heat, and mass transfer in laminar and turbulent boundary layers for internal and external flows. Convective heat transfer at high velocities. Heat transfer with change of phase. Special topics in convective heat transfer. Prerequisite: EnrE. 310 or the equivalent.

424. THERMAL RADIATION. 4 HOURS. Introduction to Planck's quantum theory. Black-body radiation; Wien's law; Stephan-Boltzmann's law. Basic concepts of total and spectral emissivity, absorptivity, reflectivity, and transmissivity. Kirchhoff's law. Radiation exchange between solid surfaces; gaseous radiation; radiation-convection interaction. Prerequisite: Consent of the instructor.

426. RADIATION GAS DYNAMICS. 4 HOURS. Basic laws and definitions of thermal radiation. Energy transfer in absorbing, emitting, and scattering media. Thin and thick approximate methods. Radiative equilibrium. Combined conduction and radiation. Combined convection and radiation. Prerequisites: EnrE. 414 or 422, and Math. 321 or the equivalent.

431. ADVANCED CHEMICAL REACTION ENGINEERING. 4 HOURS. Nonideal reactors; the effects of residence time distribution and mixedness. Heterogeneous noncatalytic reactions; gas-liquids, liquid-liquid, solid-fluid systems. Heterogeneous catalytic reactions. Time dependent systems; catalyst deactivation. Prerequisite: EnrE. 386.

432. MOLECULAR THEORY OF GAS DYNAMICS. 4 HOURS. Kinetic theory distribution functions, Liouville theorem and Boltzmann equation. Moments of Boltzmann equation. Near-equilibrium perturbations; nonequilibrium analyses; rarefied gas flows; shock structure; nonequilibrium plasmas. Prerequisites: EnrE. 304, 310, and Math. 322 or the equivalent.

434. PLASMA DYNAMICS. 4 HOURS. Electromagnetic fields: motions of charged particles; statistical description of plasmas; ionization phenomena; Landau damping; electromagnetic waves; instabilities. Prerequisite: EnrE. 432.

436. CHEMICALLY REACTING FLOWS. 4 HOURS. Nonequilibrium states; chemical thermodynamics and kinetics. Multicomponent continuum equations for flow of nonequilibrium fluids. Inviscid nonequilibrium flows. Boundary layer flows with surface and gas-phase reactions. Frozen and equilibrium criteria. Waves in relaxing media. Prerequisites: EnrE. 414 or 422, and 416.

438. SEPARATION PROCESSES. 4 HOURS. Advanced treatment of separation processes based on preferential migration. General theory. Binary and multicomponent distillation. Absorption, adsorption, and extraction processes. Gas chromatography and liquid chromatography. Dialysis, and miscellaneous other separations. Prerequisite: EnrE. 304.

439. MASS TRANSFER IN LIQUID SYSTEMS. 4 HOURS. Treatment of modern diffusion theories as applied to liquid-liquid and liquid-solid systems. Advanced treatment of molecular and macroscopic diffusional phenomena in multiphase, multicomponent systems, including theory of liquid state, ideal and nonideal solutions, coupled mechanisms in diffusion transfer, and engineering design of liquid contacting equipment. Prerequisite: EnrE. 305.

440. NON-NEWTONIAN FLUIDS. 4 HOURS. Constitutive equations for non-Newtonian fluids. Simple fluids. Viscoelasticity. Viscometric flows. Helical flow. Large elastic deformations, stress relaxation. Thermodynamics of

viscoelastic fluids. Time-temperature superposition. Transport phenomena in non-Newtonian fluids. Experimental methods and results. Prerequisite: EnrE. 316.

451. KINETICS OF GAS REACTIONS. 4 HOURS. Basic concepts of reaction rate and mechanism. Collision theory, absolute rate theory, and theory of unimolecular decomposition. Dissociation, recombination, and chain reactions. Combustion, flames, and detonations. Catalysis. Prerequisites: EnrE. 304 and 305.

484. MATHEMATICAL TECHNIQUES OF NUCLEAR REACTOR THEORY I. 4 HOURS. Same as Mathematics 484. Introduction to nuclear physics and nuclear reactor physics; flux distributions, critical mass, slowing down kernels and their Fourier transforms, two-group steady state theory in the reflected reactor, buckling iteration method, matrix methods in boundary value and criticality problems in the one-dimensional multiregion reactor, series solutions of group diffusion equations in multiregion reactor and in two-dimensional fully reflected reactor, reactor criticality codes. Prerequisites: Math. 312, 323, 341 or 348, and 381 or the equivalents.

485. MATHEMATICAL TECHNIQUES OF NUCLEAR REACTOR THEORY II. 4 HOURS. Same as Mathematics 485. Variational methods in the criticality problem, theory of control rods in cylindrical reactor, introduction to reactor kinetics, perturbation theory and applications, adjoint flux distributions, inhour equation for multiregion multifuel reactors, xenon poisoning, and override problem. Prerequisite: EnrE. 484.

486. MATHEMATICAL TECHNIQUES OF NUCLEAR REACTOR THEORY III. 4 HOURS. Same as Mathematics 486. Cylindrical reactor with source, power-level determination problem, time-dependent flux distributions in multiregion reactor, one-group model, transient and stable flux distributions in multiregion reactor, two-group model, self-limiting power bursts, analysis of nonlinear feedback problems. Prerequisite: EnrE. 485.

491. SPECIALIZED PROBLEMS. 4 TO 12 HOURS. Specialized problems under the supervision of faculty. Prerequisite: Arrangement with the faculty.

493. CURRENT TOPICS ON ENERGETICS. 4 HOURS. The particular topics will vary from quarter to quarter depending on the interests of the students and the specialties of the current instructor. Prerequisite: Consent of the instructor.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Individual research in specialized problems under the supervision of faculty. Prerequisite: Arrangement with the faculty.

ENGLISH

Professors: Jay A. Levine, Head of the Department; Paul Carroll, John Conley, John E. Hardy, Alexander Karanikas, Bernard R. Kogan, Robie Macauley (Visting), Louis A. Marder, Ralph J. Mills, John F. Nims, R.B. Ogle,

John B. Shipley, James B. Stronks, Samuel A. Weiss, Maurita Willett, Martin L. Wine

Associate Professors: Irving D. Blum, Beverly Fields, Gloria G. Fromm, Howard H. Kerr, Robert A. Kispert, Michael Lieb, Daniel A. Lindley, John H. Mackin, Patricia McFate, A. LaVonne Ruoff, Jaroslav Schejbal (Visiting), Mary Thale

Assistant Professors: Preston M. Browning, Nancy R. Cirillo, Gene W. Ruoff, Gerald C. Sorensen, Frederick C. Stern

Degree Programs

The Department of English offers courses of study leading to the Master of Arts in English, with specializations in literature (either English or American) or in creative writing.

Admission Requirements

Applicants must hold either a Bachelor of Arts or Bachelor of Science from an accredited college or university. Applicants for admission to the literature and creative writing programs must also have a major in English, or the equivalent, that includes a balanced program in English and American literature beyond the level of sophomore surveys. A student admitted with deficiencies will be required to make up prerequisites without graduate credit in his first quarter(s) in residence; the passing grade for a deficiency course is B.

Applicants must have an overall grade-point average of at least B (4.00 on a 5.00 scale) for the last 90 quarter (60 semester) hours of undergraduate study. Applicants for admission to the literature and creative writing programs must also have an English grade-point average of B+ (4.20 on a 5.00 scale).

Applicants for admission to the graduate programs in the Department of English must submit the following, unless otherwise exempted:

Three letters of recommendation, preferably from professors who are familiar with the applicant's recent work.

A statement of about 250 words presenting the applicant's reasons for wishing to take graduate work in English and the relationship of his work to his professional and other goals.

Graduate Record Examination (GRE) scores for both the general aptitude and advanced literature tests. Ordinarily, the minimum acceptable scores on these tests for admission are at the sixtieth percentile.

An applicant for admission to the creative writing program must also submit a sample of his writing (at least five poems, a story, a chapter from a novel, or comparable work).

A foreign applicant should submit GRE scores if it is possible for him to take the examination; otherwise, he may be admitted on limited status and required to take the examination in his first quarter in residence. Instead of the 250-word statement, he is required to submit a four or five page summary of his educational experience that emphasizes his work in English and American literature and language. He should conclude this summary with his reasons for wanting to do graduate work in the United States.

Degree Requirements

Master of Arts

Language: The student must present evidence of foreign-language competence before taking the M.A. examination. He may satisfy this requirement (1) by passing an upper-division (200-300 level) literature course in a classical language or in a major modern European language (others by petition) with a grade of A or B, or (2) by passing a reading examination. A creative writing student may also satisfy the requirement by successfully completing English 473, Workshop in Translation.

Examination: All candidates are required to pass a master's examination (given each spring and fall). Literature students may take English 497 for 4 quarter hours to prepare for this examination; creative writing students may do so only at the discretion of the chairman of the Program for Writers. If a student fails the examination, he may be allowed to repeat it once.

Hours: A minimum of 48 quarter hours of course work is required. At least 36 of the 48 hours must be in English; the remaining 12 hours may be in courses in other departments or disciplines approved by the student's adviser.

By graduation, the student will be required to have completed satisfactorily at least one course at the 300 or 400 level in each of the following areas in which he has *not* had course as an undergraduate. (Sophomore surveys do not fulfill this requirement.)

1. English Literature (one in each of the areas below)
    Before 1500
    Shakespeare
    Renaissance through Milton (1500-1660)
    Restoration-18th Century (1660-1789)
    Nineteenth Century (1789-1900)
2. American Literature (one in each of the areas below)
    Beginnings through Hawthorne
    Melville through Late 19th Century
3. Modern British *or* American Literature

Thesis: None is required; instead, each student will submit a *qualifying paper* (25 to 40 pages) for departmental approval. The *qualifying paper* may be an enlarged version of a paper written for a 300- or 400-level course taken as a graduate student, may have orginated in independent research, or may have arisen independently of any course. The student may enroll in English 497 for 4 hours of credit to write an acceptable *qualifying paper.*

Specialization in Creative Writing

Hours: A minimum of 48 hours of course work is required, distributed as follows: (1) at least 16 hours of 300- or 400-level literature courses (exclusive of 300-level writing courses) in the areas listed under Specialization in Literature (above) in which the student has *not* had a course as an undergraduate (sophomore surveys do not fulfill this requirement); (2) no more than 16 hours of creative writing workshops; (3) 12 hours of tutorials (English 497) or of graduate-level literature courses (exclusive of 300-level writing courses) in English or in courses in other departments or disciplines approved by the adviser.

Thesis: Each student must present a thesis consisting of a publishable volume of his work, such as a volume of poems, a novel, or a collection of stories. A miscellaneous volume containing, for example, poems, critical essays, and short stories, is also acceptable. As these writings are expected to grow out of the writing workshops, credit for English 499, Thesis Research, will not be given.

Courses for Graduate and Advanced Undergraduate Students

300. HISTORY OF THE ENGLISH LANGUAGE. 4 HOURS. English in its relationship to other languages; historical account of its development. Prerequisite: Senior standing or 12 hours of English.

301. THE STRUCTURE OF MODERN ENGLISH. 4 HOURS. Critical evaluation of traditional, structural, and transformational grammatical descriptions; detailed survey of a transformational syntax of English. Prerequisite: Engl. 300 or Ling. 305.

302. INTRODUCTION TO OLD ENGLISH. 4 HOURS. The elements of Old English grammar and the reading of graded prose selections. Prerequisite: Senior standing or 12 hours of English.

303. OLD ENGLISH POETRY AND PROSE. 4 HOURS. Representative selections of prose and poetry of England to 1200, exclusive of *Beowulf.* Prerequisite: Engl. 302 or the equivalent.

304. *BEOWULF.* 4 HOURS. A detailed explication of the poem. Prerequisite: Engl. 302 or the equivalent.

305. INTRODUCTION TO MIDDLE ENGLISH. 4 HOURS. A linguistic examination of Middle English and its dialects. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

306. ENGLISH LITERATURE OF THE MIDDLE AGES I. 4 HOURS. Representative selections; emphasis on the courtly and popular secular literature. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

307. ENGLISH LITERATURE OF THE MIDDLE AGES II. 4 HOURS. Representative selections; emphasis on the religious and moral literature. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

308. CHAUCER. 4 HOURS. A survey of Chaucer's major works. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

310. ENGLISH LITERATURE OF THE RENAISSANCE I. 4 HOURS. Representative selections; emphasis on Skelton, More, Elyot, Wyatt, Surrey, Lyly, Sidney, Spenser, and Marlowe. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

311. ENGLISH LITERATURE OF THE RENAISSANCE II. 4 HOURS. Representative selections; emphasis on Ralegh, Bacon, Donne, Jonson, Hobbes, Herbert, Browne, and Milton. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

312. RENAISSANCE DRAMA, EXCLUSIVE OF SHAKESPEARE. 4 HOURS. May be repeated for a maximum of 8 hours of credit. Content varies between Tudor drama (Udall, Norton, Sackville, Lyly, Kyd, Marlowe, Dekker, and others) and Stuart drama (Chapman, Marston, Jonson, Beaumont, Fletcher, Webster, Middleton, Rowley, and others). Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

313. SHAKESPEARE I. 4 HOURS. The poems and early plays. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

314. SHAKESPEARE II. 4 HOURS. The later plays. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

315. MILTON. 4 HOURS. A survey of Milton's poetry and prose, with emphasis on his major works. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

316. MAJOR AUTHORS IN RENAISSANCE LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a single figure, such as Spenser, Donne, Jonson. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

317. STUDIES IN RENAISSANCE LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of topic, movement, or genre. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

320. ENGLISH LITERATURE OF THE RESTORATION AND EIGHTEENTH CENTURY I: 1660 TO 1714. 4 HOURS. Representative selections; emphasis on Dryden, Restoration drama, and the early works of Swift and Pope. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

321. ENGLISH LITERATURE OF THE RESTORATION AND EIGHTEENTH CENTURY II: 1715 TO 1744. 4 HOURS. Representative selections; emphasis on the early novelists (Defoe, Richardson, and Fielding) and the later works of Swift and Pope. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

322. ENGLISH LITERATURE OF THE RESTORATION AND EIGHTEENTH CENTURY III: 1745 TO 1789. 4 HOURS. Representative selections; emphasis on the Johnson circle and the mid-century novelists (Richardson, Fielding, Sterne, and Smollett). Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

323. RESTORATION AND EIGHTEENTH CENTURY DRAMA. 4 HOURS. May be repeated for a maximum of 8 hours of credit. Restoration drama (principally Dryden, Etherege, Wycherley, Otway, Shadwell, Vanbrugh, Cibber, and Congreve) and eighteenth century drama (Addison, Steele, Gay, Fielding, Farquhar, Cumberland, Sheridan, Goldsmith, and others). Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

324. THE EIGHTEENTH CENTURY NOVEL. 4 HOURS. Representative selections; emphasis on Defoe, Richardson, Fielding, Sterne, Smollett, and some of the minor novelists of the period. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

325. MAJOR AUTHORS OF RESTORATION AND EIGHTEENTH CENTURY LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a single figure, such as Dryden, Swift, Pope, Johnson, Fielding. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

326. STUDIES IN RESTORATION AND EIGHTEENTH CENTURY LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a topic, movement, or genre. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

330. ENGLISH LITERATURE OF THE ROMANTIC PERIOD I. 4 HOURS. Representative selections; emphasis on Blake, Wordsworth, and Coleridge. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

331. ENGLISH LITERATURE OF THE ROMANTIC PERIOD II. 4 HOURS. Representative selections; emphasis on Byron, Shelley, and Keats. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

332. MAJOR AUTHORS OF THE ROMANTIC PERIOD. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a single figure, such as Blake,

Wordsworth, Coleridge, Byron, Shelley, or Keats. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

333.　STUDIES IN ROMANTIC LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a topic, movement, or genre. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

340.　ENGLISH LITERATURE OF THE VICTORIAN PERIOD I: POETRY. 4 HOURS. Representative selections; emphasis on Tennyson, Browning, Arnold, Swinburne, Hopkins, Hardy. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, and 152 recommended).

341.　ENGLISH LITERATURE OF THE VICTORIAN PERIOD II: NONFICTION PROSE. 4 HOURS. Representative selections; emphasis on Carlyle, Mill, Newman, Arnold, Ruskin, Pater. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

342.　ENGLISH LITERATURE OF THE VICTORIAN PERIOD III: THE NOVEL. 4 HOURS. Representative selections; emphasis on Dickens, Thackeray, Trollope, Eliot, Meredith, Butler, Hardy. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

343.　MAJOR AUTHORS IN VICTORIAN LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a single figure, such as Arnold, Browning, Carlyle, Dickens, Eliot, Mill, Newman, Tennyson, Thackeray, Trollope. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

344.　STUDIES IN VICTORIAN LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a topic, movement, or genre. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

350.　MODERN BRITISH LITERATURE I: 1890 TO 1930. 4 HOURS. Representative selections; emphasis on Yeats, Shaw, de la Mare, Conrad, Joyce, Woolf, Lawrence, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

351.　MODERN BRITISH LITERATURE II: 1930 TO THE PRESENT. 4 HOURS. Representative selections; emphasis on Yeats, Auden, Thomas, Spender, Greene, Huxley, Pinter, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

352.　MODERN BRITISH FICTION I: 1890 TO 1930. 4 HOURS. Conrad, Forster, Joyce, Lawrence, Woolf, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

353.　MODERN BRITISH FICTION II: 1930 TO THE PRESENT. 4 HOURS. Survey: representative selections, with emphasis on Waugh, Orwell, Williams, Wilson,

Murdoch, Powell, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

354. MODERN IRISH LITERATURE: 1880 TO THE PRESENT. 4 HOURS. May be repeated for a maximum of 8 hours of credit. Representative selections; emphasis on George Moore, Wilde, Yeats, Gregory, Synge, Stephens, Joyce, O'Faolain, O'Connor. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

355. MAJOR AUTHORS OF MODERN BRITISH LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a single figure, such as Auden, Beckett, Conrad, Joyce, Lawrence, Woolf, Yeats, or Shaw. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

356. STUDIES IN MODERN BRITISH LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a topic, movement, or genre. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

360. AMERICAN POETRY I: BEGINNINGS TO 1900. 4 HOURS. Representative selections; emphasis on Taylor, Emerson, Poe, Whitman, Dickinson, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

361. AMERICAN POETRY II: 1900 TO THE PRESENT. 4 HOURS. Representative selections; emphasis on Frost, Pound, Eliot, Cummings, Stevens, Williams, Lowell. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

362. THE AMERICAN NOVEL I: 1800 TO 1860. 4 HOURS. Representative selections; emphasis on Brown, Cooper, Hawthorne, Melville, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

363. THE AMERICAN NOVEL II: 1860 TO 1900. 4 HOURS. Representative selections; emphasis on Twain, James, Howells, Adams, Jewett, Frederic, and Norris. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

364. THE AMERICAN NOVEL III: 1900 TO 1945. 4 HOURS. Representative selections; emphasis on Dreiser, Lewis, Fitzgerald, Hemingway, Faulkner, Wolfe. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

365. THE AMERICAN NOVEL SINCE WORLD WAR II. 4 HOURS. Representative selections; emphasis on Warren, Mailer, Ellison, Nabokov, Malamud, Bellow, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

366. MAJOR AUTHORS IN AMERICAN LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a single figure, such as Hawthorne,

Melville, Whitman, Dickinson, Howells, James, Twain, Hemingway, Faulkner, and others. Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

367. PERIODS AND MOVEMENTS IN AMERICAN LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a single topic, such as the American Renaissance, Early National Literature, and the Twenties, or of such movements as Puritanism, Transcendentalism, Realism, Naturalism, Imagism, and others. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended);

368. STUDIES IN AMERICAN LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours. Study of a topic or genre. Content varies. Prerequisite: Senior standing or 12 hours of English. English 170 is recommended.

370. STUDIES IN BLACK LITERATURE. 4 HOURS. May be repeated for a maximum of 12 hours. Study of a theme, genre, movement, or author in black literature, with emphasis on American literature. Prerequisite: Senior standing or 12 hours of English. English 170 is recommended.

375. HISTORY OF LITERARY CRITICISM I. 4 HOURS. A survey, with emphasis on the major critics from Plato to Johnson. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

376. HISTORY OF LITERARY CRITICISM II. 4 HOURS. A survey of nineteenth century and modern literary criticism, with emphasis on the major critics from Wordsworth to the present. Prerequisite: Senior standing or 12 hours of English (Engl. 150, 151, 152 recommended).

383. TEACHING ENGLISH AS A SECOND LANGUAGE. 4 HOURS. Same as Education 383. The methodology of teaching English to residents of the United States who do not speak the language, especially Spanish-Americans. Prerequisite: Engl. 300 or 205 or Ling. 305.

385. STUDIES IN TEACHING THE ENGLISH LANGUAGE AND LINGUISTICS. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a topic in teaching linguistics and the English language. Content varies.

386. STUDIES IN TEACHING RHETORIC AND COMPOSITION. 4 HOURS. May be repeated for a maximum of 12 hours of credit. Study of a topic in teaching rhetoric and composition. Content varies.

390. THE WRITING OF POETRY. 4 HOURS. May be repeated for a maximum of 8 hours. Advanced practice in the writing of poetry; emphasis on analysis of student work and on published examples. Prerequisite: Satisfactory completion of Engl. 210 or the equivalent.

391. THE WRITING OF FICTION. 4 HOURS. May be repeated for a maximum of 8 hours. Advanced practice in the writing of fiction; emphasis on analysis of student work and on published examples. Prerequisite: Satisfactory completion of Engl. 211 or the equivalent.

395.   STUDIES IN BRITISH AND AMERICAN DRAMA. 4 HOURS. May be repeated
       for a maximum of 12 hours of credit. Study of an author, a topic, or a movement.
       Content varies. Prerequisite: Senior standing or 12 hours of English (Engl. 150,
       151, 152 recommended).

398.   STUDIES   IN   GENRES,   MODES,   MULTIMEDIA,   INFLUENCES,   AND
       MOVEMENTS. 4 HOURS. May be repeated for a maximum of 12 hours of credit.
       Study of a particular subject in literature. Content varies. Prerequisite: Senior
       standing or 12 hours of English (Engl. 150, 151, 152 recommended).

399.   INDEPENDENT STUDY. 1 TO 4 HOURS. Open only to English majors and
       graduate students in English. Admission to this course is only on advice of and
       initiated by the English Department. Individual studies under the direction of an
       assigned faculty member. The nature of the work is determined by the tutor on
       the basis of the student's needs and interests. Prerequisite: Senior standing.

Courses for Graduate Students

400.   INTRODUCTION TO BIBLIOGRAPHY AND RESEARCH. 4 HOURS. Required
       of graduate students in English. Detailed study of bibliographic tools and
       examination of various kinds of research papers.

405.   SEMINAR ON OLD ENGLISH. 4 HOURS. A topic on Old English; emphasis on
       literature or philology. Content varies. Prerequisite: Engl. 314 or the equivalent.

406.   INTRODUCTION TO OLD NORSE. 4 HOURS. Same as German 436. The
       grammar of Old Norse and the reading of selected prose and poetry. Prerequisite:
       A reading knowledge of some other older Germanic dialect, such as Old English,
       Old Saxon, or Gothic.

415.   SEMINAR ON MIDDLE ENGLISH LITERATURE. 6 HOURS. Individual
       conferences on assigned papers are required. Middle English and Middle Scots
       literature, exclusive of Chaucer. Prerequisite: A minimum of 4 hours in medieval
       English literature.

416.   SEMINAR ON CHAUCER. 6 HOURS. Individual conferences on assigned papers
       are required. Chaucer's works. Content varies. Prerequisite: A minimum of 4
       hours in medieval English literature.

420.   SEMINAR ON RENAISSANCE LITERATURE. 6 HOURS. May be repeated for a
       maximum of 12 hours. Individual conferences on assigned papers are required.
       One author, topic, movement, or genre. Content varies. Prerequisite: A minimum
       of 4 hours in Renaissance literature.

421.   SEMINAR ON SHAKESPEARE. 6 HOURS. May be repeated for a maximum of
       12 hours. Individual conferences on assigned papers are required. Shakespeare's
       works. Prerequisite: A minimum of 4 hours in Shakespeare.

422. SEMINAR ON MILTON. 6 HOURS. Individual conferences on assigned papers are required. Milton's works. Prerequisite: A minimum of 4 hours in Renaissance literature.

425. SEMINAR ON RESTORATION AND EIGHTEENTH CENTURY LITERATURE. 6 HOURS. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Content varies. Prerequisite: A minimum of 4 hours in Restoration and eighteenth century literature.

430. SEMINAR ON ROMANTIC LITERATURE. 6 HOURS. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, or movement. Content varies. Prerequisite: A minimum of 4 hours in Romantic literature.

435. SEMINAR ON VICTORIAN LITERATURE. 6 HOURS. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Prerequisite: A minimum of 4 hours in Victorian literature.

440. SEMINAR ON MODERN BRITISH LITERATURE. 6 HOURS. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Content varies. Prerequisite: A minimum of 4 hours in modern British literature.

445. SEMINAR ON AMERICAN LITERATURE. 6 HOURS. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, or movement. Content varies. Prerequisite: A minimum of 4 hours in American literature.

447. SEMINAR ON BLACK LITERATURE. 6 HOURS. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. One author, topic, movement, or genre. Content varies. Prerequisite: A minimum of 4 hours in Black literature or American literature.

455. TEACHING COLLEGE ENGLISH. 4 HOURS. Pass or fail grade only. Methods, materials, and practice in teaching college composition.

470. PROGRAM FOR WRITERS: POETRY WORKSHOP. 4 HOURS. May be repeated for a maximum of 12 hours. Emphasis on discussion of poems written by the students. Prerequiste: Admission to the Program for Writers.

471. PROGRAM FOR WRITERS: FICTION WORKSHOP. 4 HOURS. May be repeated for a maximum of 12 hours. Emphasis on discussion of fiction written by the students. Prerequisite: Admission to the Program for Writers.

472. PROGRAM FOR WRITERS: CRITICISM WORKSHOP. 4 HOURS. May be repeated for a maximum of 12 hours. Emphasis on discussion of criticism written by the students. Prerequisite: Admission to the Program for Writers.

473. PROGRAM FOR WRITERS: TRANSLATION WORKSHOP. 4 HOURS. May be repeated for a maximum of 12 hours. Emphasis on discussion of translation by the students. Prerequisite: Admission to the Program for Writers.

474. PROGRAM FOR WRITERS: NONFICTION WORKSHOP. 4 HOURS. May be repeated for a maximum of 12 hours. Emphasis on discussion of nonfiction written by the students. Prerequisite: Admission to the Program for Writers.

475. PROGRAM FOR WRITERS: EXPERIMENTAL WRITING WORKSHOP. 4 HOURS. May be repeated for a maximum of 12 hours. Emphasis on discussion of experimental writing by the students. Prerequisite: Admission to the Program for Writers.

480. SEMINAR ON GENRES OF LITERATURE. 6 HOURS. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. A single genre, such as poetry, fiction, nonfiction, drama, or literary criticism.

481. SEMINAR ON LITERATURE AND RELATED FIELDS. 6 HOURS. May be repeated for a maximum of 12 hours. Individual conferences on assigned papers are required. The relationship between literature and such fields as the fine arts, philosophy, psychology, religion, science, and sociology. Prerequisite: A minimum of 4 hours in the area of the literature to be studied.

497. RESEARCH IN ENGLISH. 2 TO 8 HOURS. May be repeated for a total of 16 hours. Students are assigned to this course at the discretion of the department. Independent research in English and American literature, linguistics, and creative writing.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Students are assigned to this course at the discretion of the department. For students involved in thesis research and writing for advanced degrees.

GEOGRAPHY

Clifford E. Tiedemann, Chairman of the Department

Professors: James M. Blaut, Edwin Thomas

Associate Professors: Edwin Draine, James Landing, David Soltzman, Clifford E. Tiedemann

Assistant Professors: Yehoshua S. Cohen, Bruce G. Gladfelter, Albert J. Larson, Siim Soot

The Department of Geography offers work leading to the Master of Arts in two areas of specialization: urban geography and environmental studies. This is an intercampus degree program, offered in cooperation with the Urbana-Champaign campus of the University of Illinois. The typical program chosen by the student, in consultation with a faculty adviser, will devote at least one-fourth of the time to courses directly related to one of these two

areas of emphasis. In addition it is assumed that the departmental electives will support the area chosen by the student and that work outside the department will complement his work in geography. The required thesis will be in the student's area of emphasis.

Admission Requirements

Applicants must have a baccalaureate from an accredited college or university, meet the requirements for admission to the Graduate College, and have a grade-point average of 4.00 (A=5.00) for the final 90 quarter hours (60 semester hours) of undergraduate study. Students with averages between 3.50 and 4.00 may petition for consideration for admission. Applicants who have majored in fields other than geography must remedy deficiencies in their geography backgrounds.

Prospective students are invited to submit scores on the Graduate Record Examination.

Degree Requirements

Credit Distribution: A minimum of 48 quarter hours of approved graduate work, of which at least 12 hours must be in 400-level geography courses and 12 hours in individual research activities within the Department of Geography. From 6 to 12 of the 48 quarter hours required for the degree must be earned outside of the Department of Geography in a complementary discipline recognized by the student's permanently assigned adviser and the department's graduate adviser as pertinent to the student's overall program.

Thesis: Candidates must submit an acceptable thesis. From 8 to 12 quarter hours in Geography 499, Thesis Research, may be credited toward the Master of Arts in geography. The preparation of the thesis will be supervised by the student's faculty adviser, and its final form must be approved by the committee before the comprehensive examination is scheduled.

Comprehensive Examination: A degree candidate must satisfactorily complete an oral comprehensive examination covering his research activities; topics will be selected from the student's area of emphasis, and from the overall area of geography.

Should the student fail the comprehensive examination, he will be advised to take additional course work, or undertake independent study, or do further research on his thesis topic to prepare him for a second examination, which will be given *no sooner* than the last week of the succeeding term. If the second examination is failed, the student will be terminated.

Courses for Graduate and Advanced Undergraduate Students

301. ADVANCED LANDFORM GEOGRAPHY. 4 HOURS. Examination of the surficial processes modifying the earth's landforms; the controls over those processes and their regional settings. Prerequisites: Geog. 190 and 201.

303. PRINCIPLES OF CLIMATOLOGY. 4 HOURS. Climatology; macroclimatology and microclimatology; particular emphasis on fluxes of energy and mass at the interfaces between the earth's surface and the atmosphere. The environment and man, plants, and animals; special emphasis on urban microclimatological problems. Prerequisites: Geog. 190 and 203.

306. FUNDAMENTALS OF LANDFORM ANALYSIS. 3 HOURS. Theories of landform processes and techniques of analysis. Prerequisite: Geog. 101 or GeolS. 102.

310. PRINCIPLES OF CULTURAL AREA ANALYSIS. 4 HOURS. Analysis and application of a wide variety of techniques developed to aid in defining, identifying, evaluating, and bounding world cultural areas. Special attention is paid to techniques applicable to urban environments. Examination of development of areal cultural hierarchies through the diffusion mechanisms that create them. Prerequisites: Geog. 190 and 210.

311. GEOGRAPHY OF POPULATION. 4 HOURS. Broad treatment of the problems created by the changing distributions and numbers of the world's population. Emphasis on the relationships between population and resources; intensive study of the implications for both overpopulated and underpopulated areas of the world. Prerequisites: Geog. 190 and 210.

312. GEOGRAPHY OF RELIGIONS. 4 HOURS. Same as Religious Studies 312. Systematic treatment of geographical manifestations of the major religious systems of the world. Special attention to the geographical origins and dispersal mechanisms of religious systems and to the manner in which man organizes his life within the framework of his belief. Intensive study of applications being made in the geographical inquiry of religious systems. Prerequisites: Geog. 190 and 210.

315. PRINCIPLES OF HISTORICAL GEOGRAPHY. 4 HOURS. Development of an understanding of relating phenomena in space through time. Application of contemporary geographic research methodologies to geographically significant aspects of historic patterns and events. Prerequisites: Geog. 190 and 210.

320. ETHNOGEOGRAPHY. 4 HOURS. Cross-cultural analysis of environmental behavior and environmental cognition (ethnoscience) of the systems of resource-use in which these processes are imbedded, and of their relationship to cultural change and technological growth. Prerequisites: Geog. 220 and Anth. 200.

326. DECISION MAKING AND RESOURCE MANAGEMENT. 4 HOURS. The nature of decision-making schema in resource management; intensive study of

approaches used in analyzing resource management decisions; case studies are analyzed in terms of the character of decisions and strategies reflected, with emphasis on environmental hazards. Prerequisites: Geog. 190, 226.

330.   LOCATION THEORY AND SPATIAL ANALYSIS. 4 HOURS. Spatial analysis in relation to theories of location of economic activity and regional development; theoretical systems; development and derivation of locational patterns of agricultural, manufacturing, and tertiary activities. Prerequisites: Geog. 190 and one course chosen from Geog. 230, 231, 233, or 235; or Econ. 121 or Mktg. 360.

335.   GEOGRAPHICAL MODELING OF TRANSPORTATION SYSTEMS. 4 HOURS. Discussion of the principles of spatial interaction; emphasis on commodity flows and passenger movements, the practicality of network analysis, and the impact of transportation facilities on land use and regional development. Techniques include simulation and evaluation of existing transportation systems and solutions to theoretical transportation problems. Prerequisite: Geog. 235 or 383.

350.   AREAL   ORGANIZATION   OF   INTRA-URBAN   SYSTEMS.   4   HOURS. Geographic aspects of intracity relationships. Topics include the city as a complex man-machine system, and areal patterns of urban growth and development within the context of cross-sectional and longitudinal models. Prerequisites: One upper-division research methods course, one two-course systematic sequence, and one course in the 250 series or one course in the 360 series.

351.   AREAL   ORGANIZATION   OF   INTERURBAN   SYSTEMS.   4   HOURS. Geographic aspects of intercity relationships. Topics include patterns of intercity flows and development, continuous and hierarchical ordering of urban places, measurement of areal alignments, and the theoretical implications of different types of areal patterns. Prerequisites: One upper-division research methods course, one two-course systematic sequence, and one course in the 250 series or one course in the 360 series.

361.   PROBLEMS OF THE HUMID TROPICS. 4 HOURS. Natural and human aspects of tropical areas; problems of the humid environment relating to landforms, land use, resources, economic and social phenomena and institutions; emphasis on the development potential of humid, tropical lands. Individual research projects are assigned. Prerequisites: One upper-division research methods course, one two-course systematic sequence, and one course in the 260 series or one course in the 350 series.

362.   PROBLEMS OF ARID REGIONS. 4 HOURS. Natural and human aspects of arid areas; problems of the environment relating to landforms, land use, resources, and economic and social phenomena and institutions; emphasis on the development potential of arid lands. Individual research projects are assigned. Prerequisites: One upper-division research methods course, one two-course systematic sequence, and one course in the 260 series or in the 350 series.

365.   INTERREGIONAL EXCHANGE DYNAMICS. 4 HOURS. Spatial analysis of the economic, social, and political facts that have resulted from, and in, human and

commodity flows among regions; special attention to the important relationships resulting from regional differences. Prerequisites: One upper-division research methods course, one two-course systematic sequence, and one course in the 260 series or one in the 350 series.

369.   FIELD GEOGRAPHY OF SELECTED WORLD REGIONS. GRADUATE STUDENTS: 6 HOURS; UNDERGRADUATE: 12 HOURS. May be applied only once toward degree requirements. A full-quarter field course covering a selected geographic region of the world. Lectures, discussions, special readings, projects, and field work are integral parts of the course. Prerequisites: *Geography majors:* Geog. 190, two 200-level systematic geography courses, and consent of the instructor. *Others:* One year of upper-level social science courses and consent of the instructor.

370.   THE LEARNING AND TEACHING OF GEOGRAPHY. 4 HOURS. A formal approach to instructional strategies in geography centered upon the known behavioral and learning characteristics of students. Strong emphasis on material presentation in contemporary urban schools. Prerequisites: Senior standing and declared major in teacher education.

381.   GEOGRAPHIC INFORMATION SYSTEMS I. 4 HOURS. Problems encountered in the gathering and use of geographic data and the structuring of research in relation to existing relevant theory, measurement systems capabilities, and recognized objectives of research activities. Topics include review of data sources, methods of measurement, sampling models, and problems of dealing with aggregated reporting units, records matching, and missing data. Prerequisites: Geog. 182, 190 (or Math. 117, or Soc. 185, or QM 272), one 12 hour introductory sequence, and one 8 hour systematic sequence.

382.   GEOGRAPHIC INFORMATION SYSTEMS II. 4 HOURS. Application of inferential statistical techniques and probability models in geographic research. Topics include use of descriptive parameters in recognizing geographic relationships, tests of significance, and recognition of particular areal patterns. Prerequisite: Geog. 381.

383.   GEOGRAPHIC INFORMATION SYSTEMS III. 4 HOURS. Problems encountered in the management and portrayal of geographic data. Topics include preparation of data for manual and machine processing, data condensation and characterization, observation indexing, and the preparation of graphic and tabular displays. Prerequisite: Geog. 382.

385.   THEMATIC CARTOGRAPHY. 4 HOURS. Discussion and experiments involving graphic representation of real-world areal patterns; preservation of geodetic and information properties; information generalization and reconstruction; semiotic problems and communications capabilities of mapped informational displays. Prerequisites: Geog. 285 or 382 and consent of the instructor.

386.   INTRODUCTION TO AREAL PATTERNS. 4 HOURS. The characteristics and evaluation of selected real-world patterns. Application of the concepts of randomness and interdependence to the problem of understanding certain of the

physical and cultural processes affecting the arrangement of objects in the landscape. Prerequisites: Geog. 286 or 382 and consent of the instructor.

387.   REMOTE SENSING OF THE ENVIRONMENT. 4 HOURS. Principles and practice in interpretation of aerial photographs, radar, and infrared imagery. Knowledge of elementary physics and geometry is recommended. Prerequisite: Geog. 287.

391.   REVIEW OF GEOGRAPHIC THOUGHT AND RESEARCH METHODS. 4 HOURS. Introduction to the theory and techniques of geographic research; modern geographic philosophy; interpretative analysis of bibliographic sources and the preparation of a bibliography; preparation and evaluation of individual papers on selected topics. Prerequisites: Two two-course systematic sequences, one upper-division research methods course, one 300-level urban or regional course, and consent of the instructor.

Courses for Graduate Students

410.   SEMINAR ON SOCIAL AND CULTURAL GEOGRAPHY. 3 HOURS. May be repeated up to a maximum of 9 hours. A research course in the analysis of the mechanisms of cultural change with spatial impact. Emphasis on the identification of trait and culture complexes that result in differentially organized areas, and the diffusion mechanisms that either accelerate or retard such development. Prerequisite: Geog. 310.

415.   SEMINAR ON HISTORICAL GEOGRAPHY. 3 HOURS. May be repeated up to a maximum of 9 hours. A research course in the development of expertise in the techniques of analysis through the integration of history and geography. Methodology is centered on macro-studies (evolutionary perspectives on the development of spatial patterns in large areas) and micro-studies (small-scale studies of areas or groups). Prerequisite: Geog. 315.

426.   SEMINAR ON MANAGEMENT AND CONSERVATION OF RESOURCES. 3 HOURS. May be repeated up to a maximum of 9 hours. The role of perception of the environment in resource management. Special attention to geographical research on perception of natural hazards. Needs for further research are examined. Prerequisite: Geog. 326.

430.   SEMINAR ON SPATIAL ECONOMIC ANALYSIS. 3 HOURS. Primarily economic geography. Selected theories of location of economic activities and regional growth and development. Topics may include the location of agricultural, manufacturing, and tertiary activities. Findings in conventional economic theory and in regional economics; impact on location and on development of behavior of firms and institutions. Topics vary each quarter. Prerequisite: Geog. 330.

435.   SEMINAR ON URBAN TRANSPORTATION SYSTEMS. 3 HOURS. May be repeated up to a maximum of 9 hours. Evaluation of the impact of public and private transit on city land-use structure; review of the degree to which the transit facilities serve the population. Metropolitan transportation systems are contrasted

with the social, economic, and ethnic structure of urban areas. Analysis includes practical and theoretical models. Prerequisites: Geog. 335 and 351 or the equivalent.

450. URBAN GEOGRAPHY. 3 HOURS. The areal organization of metropolitan communities; emphasis on geographic patterns of activities within the city. Geographic aspects of an urban system emphasizing integrating and specialization factors affecting the American urban system. Prerequisite: Geog. 351.

459. SEMINAR ON URBAN GEOGRAPHY. 3 HOURS. May be repeated up to a maximum of 9 hours. Selected aspects of urban geography. Topics vary from term to term. Prerequisite: Geog. 450.

460. CONCEPTS OF REGIONAL GROWTH AND DEVELOPMENT. 3 HOURS. The concept of a region. Interregional income differentials. Factor mobility, determinants of regional growth, regional development strategies. Prerequisites: Geog. 361 and 362 or credit in one and concurrent registration in the other.

469. SEMINAR ON REGIONAL DEVELOPMENT. 3 HOURS. May be repeated up to a maximum of 9 hours. Analysis of the role of resources in regional development, with emphasis on integrated river-basin development. Specific topics may change from year to year. Prerequisite: Geog. 460.

470. SEMINAR ON GEOGRAPHIC LEARNING. 3 HOURS. May be repeated up to a maximum of 9 hours. Research course involving applications of modern learning theory to the teaching of geographic concepts. Emphasis on teaching techniques to maximize geographic information flow with minimal energy expenditure for both student and teacher. Experience with learners at various levels is an integral part of the work. Prerequisite: Geog. 370

481. SPATIAL ANALYSIS IN GEOGRAPHY. 3 HOURS. May be repeated up to a maximum of 9 hours. The role of hypothesis testing in geographic research. Methods of testing spatial associations, ranging from simple correlation to generalized mapping surfaces. Emphasis on residual analysis and the related problems of autocorrelation and varying unit size. Prerequisites: Geog. 381, 382, and 383 or the equivalents.

490. GEOGRAPHIC FIELD RESEARCH METHODOLOGY. 4 HOURS. A problem-oriented introduction to primary data collection in geographic research. Group and individual involvement in formulation and analysis of small-area research problems. Written and oral reports on individually assigned projects are evaluated by a faculty committee. Several all-day field trips are required. Prerequisite: Credit or concurrent registration in Geog. 391.

492. FRONTIERS IN GEOGRAPHIC RESEARCH. 2 HOURS. Required of all graduate geography majors. A formal, intensive examination of contemporary geographic research in the various subfields of the discipline. Prerequisites: Geog. 391, 490.

494. SPECIAL READINGS IN GEOGRAPHY. 1 TO 4 HOURS. May be repeated up to a maximum of 8 hours. Independent readings on an approved topic for those

desiring further acquaintance with advanced thought and methodology in geography without involvement in a research project or a field study. Prerequisite: Approval of the department student adviser.

495.   SPECIAL STUDIES IN GEOGRAPHY. 1 TO 4 HOURS. May be repeated for credit up to a maximum of 8 hours. Independent research on an approved topic not related to thesis preparation. Prerequisite: Approval of the department student adviser.

499.   THESIS RESEARCH IN GEOGRAPHY. 0 TO 16 HOURS. May be repeated for credit up to a maximum of 16 hours. Independent research on a topic approved for a graduate thesis. Prerequisite: Approval of the appropriate department committee.

GEOLOGICAL SCIENCES

Professors: Werner H. Baur, Head of the Department; Joseph I. Lipson, Richard B. McCammon, Edward Olsen (Adjunct, Field Museum)

Associate Professors: Robert E. DeMar, Warren C. Forbes, Jr., Kelvin S. Rodolfo, Norman D. Smith

Assistant Professors: David W. Baker, John R. Bolt (Adjunct, Field Museum), August F. Koster van Groos, Zubair A. Saleem

Work leading to the Master of Science is offered in these areas: crystallography, mineralogy, petrology, geochemistry, paleontology, oceanography, sedimentology, hydrology, and environmental geology.

Admission Requirements

Admission usually requires a minimum grade-point average of 4.00; however, the department will rely strongly on recommendations from the applicant's undergraduate professors and on the grade-point average attained in the last two years of college. Geology students with a strong background in mathematics, physics, chemistry, and biology will receive preference, although students who have degrees in other sciences may be admitted. Serious deficiencies in undergraduate training in geology or in other sciences must be removed. The program, selected by the student in consultation with his adviser, will be determined by the area of specialization. Applicants are requested to take the Graduate Record Examination.

Degree Requirements

Hours: 48 quarter hours, 24 of which must be in the area of concentration, which may, as in evolutionary paleontology, for example, span several academic disciplines. A minimum of 16 quarter hours must be taken in 400-level courses, 8 of them in the area of concentration.

Thesis: The student must complete a thesis involving 8 quarter hours of work on a research project selected with the approval of his faculty supervisor. The department may request the student to take a comprehensive examination in his area of specialization. The thesis will be evaluated by a department committee that may include one member selected from outside the faculty of Chicago Circle.

Candidates must demonstrate competence in reading the scientific literature of at least one foreign language. French, German, and Russian are the preferred languages.

Courses for Graduate and Advanced Undergraduate Students

300.   MINERALOGY. 4 HOURS. Crystal chemistry and phase equilibria of minerals and mineral assemblages. Prerequisites: Chem. 114 and GeolS. 210.

310.   IGNEOUS AND METAMORPHIC PETROLOGY. 4 HOURS. Discussion of petrogenesis; application of thermodynamic principles to the crystallization of rocks. Prerequisites: Chem. 114 and GeolS. 210.

315.   SEDIMENTOLOGY. 4 HOURS. Composition, texture, and structures of sediments and sedimentary rocks. Environmental factors that control sediment genesis. Theory and techniques of modern sedimentology. Prerequisites: Chem. 114, GeolS. 215, and credit or registration in Math. 131.

316.   INVERTEBRATE PALEONTOLOGY. 4 HOURS. Same as Biological Sciences 316. Phylogeny, morphology, and ecology of the fossil invertebrates. Prerequisites: GeolS. 218 and consent of the instructor.

318.   VERTEBRATE PALEONTOLOGY. 4 HOURS. Same as Biological Sciences 318. Phylogeny, morphology, and ecology of the fossil vertebrates. Prerequisites: BioS. 281 and consent of the instructor.

319.   PALEOBOTANY. 5 HOURS. Same as Biological Sciences 319. Structure, phylogeny, and stratigraphic distribution of representative fossil plants. Lecture, laboratory, and field trips. Prerequisite: One year of biological sciences.

320.   ANALYSIS OF GEOLOGIC STRUCTURES. 4 HOURS. Elementary stress and strain relations for earth materials. Nature and origin of folds and faults.

Structural petrology. Deformation of the earth's crust. Prerequisites: Math. 130 and credit or registration in Phys. 101 or 111.

330. ENVIRONMENTAL GEOLOGY. 4 HOURS. Geological aspects of man's environment; emphasis on the earth's processes, resources, and physical properties of rocks and soils insofar as they are important to, or in some way affect, human activities. Prerequisites: Credit or concurrent registration in Math. 132 and GeolS. 225.

335. GEOCHEMISTRY. 4 HOURS. Principles of the distribution of the elements in the earth's crust. Element partitioning between coexisting minerals; origin of the elements. Introduction to thermodynamic consideration of mineral equilibria. Prerequisite: Chem. 114.

337. ELECTRON MICROPROBE ANALYSIS. 4 HOURS. Principles and techniques of electron-probe microanalysis. Prerequisite: Phys. 114 or the equivalent.

345. ADVANCED CRYSTALLOGRAPHY. 4 HOURS. Crystalline properties of minerals. Theory and practice of determining the crystalline structure of minerals. Prerequisite: GeolS. 300.

350. HYDROGEOLOGY. 4 HOURS. The occurrence, storage, movement, and quality of water in rocks of the earth's crust. Prerequisite: Math. 132.

360. INTRODUCTORY GEOPHYSICS. 4 HOURS. The shape and figure of the earth, gravity, seismology, and magnetism. Thermodynamics of the earth; atmospheric and planetary geophysics. Prerequisite: Consent of the instructor.

365. STATISTICAL METHODS IN GEOLOGY. 4 HOURS. Introductory course. Sampling from geological populations, statistical inference, and hypothesis testing; statistics of orientation data; trend surface methods; multivariate correlation techniques; time series analysis. Prerequisite: Math. 370.

370. ENGINEERING GEOLOGY. 4 HOURS. Applications of geology to major engineering problems and operations. Prerequisites: Math. 132 and Phys. 112.

375. COMPUTER APPLICATIONS IN GEOLOGY. 4 HOURS. Introduction to computer applications in geology. Machine contouring, trend surface analysis, and spatial filtering. Graphic correlation, factor analysis, and classification systems. Simulation of geological processes, geologic sampling, and spatial variation. Prerequisite: Math. 195.

380. EARTH SCIENCE FOR TEACHERS. 9 HOURS. Survey of the earth sciences; particular attention to the Earth Science Curriculum Project (ESCP) materials. Emphasis on the interdisciplinary nature of and investigative approach toward earth science. Prerequisites: Bachelor's degree in science or mathematics, enrollment in NSF In-Service Institute for Secondary School Teachers, and consent of the instructor.

385. GEOPHYSICAL EXPLORATION. 4 HOURS. Introduction to methods of geophysical exploration. Interpretation of seismic data, gravity and magnetic

anomalies, and electrical and electromagnetic surveys. Laboratory includes field investigations. Prerequisites: Math. 133 and GeolS. 360.

390.   TOPICS IN MODERN GEOLOGY. 4 HOURS. Discussion of current research topics. Prerequisites: Senior standing and 20 hours of advanced courses in geological sciences.

Courses for Graduate Students

410.   ADVANCED PETROLOGY. 4 HOURS. May be repeated for credit. Selected topics, generation and properties of magmas, formation of metamorphic rocks. Reaction rates in metamorphic rocks. Prerequisites: GeolS. 310 and consent of the instructor.

413.   PROBLEMS IN EVOLUTIONARY PALEONTOLOGY. 4 HOURS. Same as Biological Sciences 413. Seminar on current problems. Discussion of evidence and mechanisms of change, such as rates of evolution, population structure, and extinction as shown by the vertebrate fossil record. Prerequisite: Consent of the instructor.

415.   ADVANCED SEDIMENTOLOGY. 4 HOURS. May be repeated. Advanced topics in one of the following: clastic sedimentation models, carbonate sedimentology, sediment transport and sedimentary petrology. Lectures, seminar, and laboratory. Prerequisites: GeolS. 315 and consent of the instructor.

420.   ADVANCED VERTEBRATE PALEONTOLOGY. 4 HOURS. Same as Biological Sciences 420. Given as three different courses. May be repeated twice for credit. Advanced treatment of the functional morphology, paleoecology, and phylogeny of the various vertebrate groups; fishes, amphibians and reptiles, and mammals. Prerequisites: BioS. 282 and GeolS. 318.

430.   ADVANCED MINERALOGY. 4 HOURS. May be repeated if the same topic is not covered twice. Various topics in one of the following categories: structural mineralogy, X-ray crystallography, optical properties of minerals, and crystal chemistry and mineral synthesis. Lectures, seminars, and laboratory. Prerequisites: GeolS. 206 and consent of the instructor.

432.   ADVANCED GEOCHEMISTRY. 4 HOURS. May be repeated if the same category is not covered twice. Advanced topics in one of the following categories: isotope geochemistry and geochronology, distribution of elements in the earth's crust, mineral systems with and without volatile components, and low-temperature mineral systems. Lectures, seminars, and laboratory. Prerequisites: GeolS. 335 and consent of the instructor.

440.   GROUND-WATER SEMINAR. 4 HOURS. May be repeated if the same topic is not covered twice. Selected topics in ground-water hydrology. Prerequisites: GeolS. 350 and credit or concurrent registration in Math. 220.

460. MARINE GEOLOGY. 4 HOURS. Origin and nature of marine sediments, tectonics and geomorphology of the ocean floor, including methods of mapping and measuring submarine topography. Prerequisite: Consent of the instructor.

495. ADVANCED STUDIES IN GEOLOGY. 2 TO 8 HOURS. May be repeated twice. Independent study or research, under a faculty supervisor, culminating in a written report. Work may be taken in the following fields: stratigraphy, sedimentation, paleontology and paleoecology, vertebrate paleontology, mineralogy and petrology, crystallography, geochemistry, engineering geology, oceanography. Prerequisites: Consent of the head of the department and the faculty member who will act as study supervisor.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Individual work under the supervision of faculty members in their respective fields. Prerequisites: Consent of the thesis supervisor and the head of the department.

GERMAN

Professors: Robert R. Heitner, Head of the Department; Lee B. Jennings, Robert Kauf, Daniel C. McCluney, Jr., Leroy R. Shaw, Elizabeth Teichmann, Hazel C. Vardaman

Associate Professors: Arnold J. Hartoch, Karl F. Otto, Jr., Marilyn J. Torbruegge, Ernest S. Willner

Assistant Professors: Thomas A. Buesch, Heinz C. Christiansen, John S. Groseclose, Rudolph A. Hofmeister, Edward J. Stone, Dennis Q. Taylor, David M. Weible

Work leading to the Master of Arts is offered in two areas of specialization: German literature and German philology and linguistics. In addition, the department participates in an intercampus program with the Department of German on the Urbana-Champaign campus of the University of Illinois that offers work leading to the Doctor of Philosophy in German. Students admitted to this program will be required to take at least one semester of full time academic work on the Urbana-Champaign campus.

Admission Requirements

An applicant must have a bachelor's degree with a major in German from an accredited institution or the equivalent from a foreign university. Those whose undergraduate preparation in German is deemed inadequate may be admitted at the discretion of the department but will be required to take supplementary course work on the undergraduate level. An applicant is

expected to have a grade-point average of 4.00 (A=5.00) in his undergraduate work in German; those with averages between 3.50 and 4.00 may be considered.

Entering students must have the ability to read literary and critical German with speed and accuracy and to follow class lectures in German. They should also have an elementary acquaintance with German linguistics and some knowledge of the main outlines of German literature from 1750 to the present.

Degree Requirements

Program A (A thesis is not required.)
1. A minimum of 48 hours of course work, including at least 36 hours in the major field, 18 of which must be in 400-level courses.
2. At least one graduate seminar in German.
3. A one-hour oral examination and a three-hour written comprehensive examination.

Program B (A thesis is required.)
1. A minimum of 36 quarter hours of course work, including at least 24 hours in the major, 18 of which must be in 400-level courses.
2. At least one graduate seminar in German.
3. A master's thesis.

Courses for Graduate and Advanced Undergraduate Students

320. **WRITING AND SPEAKING GERMAN V. 4 HOURS.** Prerequisite: Ger. 204 or the equivalent.

321. **WRITING AND SPEAKING GERMAN VI. 4 HOURS.** Prerequisite: Ger. 320 or the equivalent.

370. **THE GERMAN *NOVELLE*. 4 HOURS.** Reading and interpretation of representative *Novellen* of the nineteenth and twentieth centuries. Prerequisites: Ger. 221 and two additional German literature courses.

372. **GERMAN DRAMA. 4 HOURS.** Development from the Enlightenment to the present. Prerequisites: Ger. 221 and two additional German literature courses.

374. **POETRY FROM THE SEVENTEENTH CENTURY TO THE PRESENT. 4 HOURS.** Prerequisites: Ger. 221 and two additional German literature courses.

380. **GOETHE'S *FAUST*. 4 HOURS.** Intensive study of Parts I and II. Prerequisites: Ger. 221 and two additional German literature courses.

382. GERMAN LITERATURE TO 1750. 4 HOURS. Prerequisites: Ger. 221 and two additional German literature courses.

385. GERMANIC LINGUISTICS. 4 HOURS. Linguistic geography, *Sprachschichten,* and principles of structural linguistics. Prerequisite: Ger. 203 or the equivalent.

390. TOPICS IN GERMAN LITERATURE. 4 HOURS. May be taken more than once for credit. Reading and discussion of the work of one prominent German author or of a group of related authors. Subject varies and is chosen by the instructor. Prerequisites: Ger. 290, 292, and 294.

Courses for Graduate Students

404. THEORIES OF GERMAN PHONETICS AND PHONOLOGY. 4 HOURS. Introduction to phonological and phonetical analysis of the German language. Prerequisite: Consent of the instructor.

405. HISTORY OF THE GERMAN LANGUAGE. 4 HOURS. Structural and lexical development.

407. TEACHING METHODS FOR GRADUATE ASSISTANTS. 1 HOUR. May be repeated twice for credit. Prerequisite: Appointment as a teaching assistant in German.

408. BIBLIOGRAPHY AND RESEARCH METHODS. 4 HOURS.

410. MIDDLE HIGH GERMAN. 4 HOURS.

420. MEDIEVAL LITERATURE. 4 HOURS. German literature from 1100 to 1400. Prerequisites: Ger. 382 and 410 or the equivalents.

421. RENAISSANCE AND REFORMATION LITERATURE. 4 HOURS. Prerequisite: Ger. 382 or the equivalent.

422. BAROQUE LITERATURE. 4 HOURS. Prerequisite: Ger. 382 or the equivalent.

423. ENLIGHTMENT AND *STURM UND DRANG* LITERATURE. 4 HOURS.

425. GOETHE AND SCHILLER—THE WEIMAR PERIOD. 4 HOURS.

426. ROMANTICISM. 4 HOURS. Literature, theories, and philosophy of eighteenth and nineteenth-century German romanticism.

427. POETIC REALISM. 4 HOURS. German literature between romanticism and naturalism.

428. MODERN GERMAN LITERATURE FROM 1890 TO 1930. 4 HOURS.

429. CONTEMPORARY LITERATURE. 4 HOURS. German drama, lyric and narrative prose from 1930 to the present.

432.   OLD HIGH GERMAN. 4 HOURS. Introduction to sounds, morphology, and syntax. Reading of Old High German literary texts. Prerequisite: Ger. 405.

433.   OLD SAXON. 4 HOURS. Introduction to sounds, morphology, and syntax. Reading of Old Saxon literary texts. Comparison of Old Saxon, Old English, and Old High German. Prerequisite: Ger. 405.

434.   GOTHIC. 4 HOURS. Introduction to sounds, morphology, and syntax. Reading of Gothic literary texts. Prerequisite: Ger. 405.

436.   INTRODUCTION TO OLD NORSE. 4 HOURS. Same as English 406. The grammar of Old Norse and the reading of selected prose and poetry. Prerequisite: A reading knowledge of some other older Germanic dialect such as Old English, Old Saxon, or Gothic.

440.   SEMINAR ON LITERATURE. 4 HOURS. May be repeated for credit. Topics vary. Prerequisite: Consent of the instructor.

441.   SEMINAR ON LINGUISTICS. 4 HOURS. May be repeated for credit. Topics vary. Prerequisite: Consent of the instructor.

447.   LABORATORY MEASUREMENT OF PHONETICS. 4 HOURS. Electroacoustic analysis of spoken German by means of special instruments for automatic graphic recording in the German Linguistic Research Laboratory. Prerequisites: Ger. 404 and consent of the instructor.

448.   THE STRUCTURE OF MODERN GERMAN. 4 HOURS. Structural analysis of modern High German by means of modern European and American methods. Prerequisites: Ger. 385 and 405.

490.   INDEPENDENT STUDY FOR GRADUATE STUDENTS. 1 TO 4 HOURS. Prerequisite: Consent of the instructor.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Prerequisite: Approval of the department.

HISTORY

Ronald P. Legon, Chairman of the Department
Professors: Shirley A. Bill, Bentley B. Gilbert, Louis Gottschalk (Adjunct), Robert L. Hess, Peter d'A. Jones, Stanley Mellon, Robert L. Nicholson, Gilbert Osofsky, Robert V. Remini, Max Savelle (Visiting), Edward C. Thaden, John B. Wolf

Associate Professors: Robert E. Conrad, James E. Cracraft, Gerald Danzer, Carolyn A. Edie, Melvin G. Holli, George Huppert, Richard Jensen, David P. Jordan, Ronald P. Legon, Peter R. McKeon, Richard Millman

Assistant Professors: Richard Fried, William A. Hoisington, Richard Levy, Michael Perman, Leo Schelbert, Peter J. Stanley

The Department of History offers work leading to the Master of Arts and the Doctor of Philosophy.

Admission Requirements

Applicants must have a grade-point average of at least 4.00 (A=5.00) for the last 90 quarter hours of undergraduate study. Students with averages below 4.00 but above 3.75 are considered on an individual basis. Three letters of recommendation from former professors are required of all applicants. Students are urged to take the Graduate Record Examination, although it is not required.

Hours: A student must present a Bachelor of Arts with a major in history or with a minimum of 24 quarter hours in history or he may petition the department for admission. Only in the most exceptional cases will part-time students be admitted as Master of Arts candidates. (Full time is defined as 12 or more quarter hours.) The department may require a candidate to make up any deficiencies in his preparation before granting him full standing in the graduate program. A minimum of two years of undergraduate training in a foreign language is required.

Degree Requirements

Master of Arts

The candidate must pass a comprehensive examination in one major field and two minor fields selected from among the following areas of specialization: the ancient world, medieval Europe, early modern Europe, modern Europe, Russia, Great Britain, Latin America, United States, Africa, imperialism and colonialism, and historiography. Candidates are expected to take at least 12 hours in each of two of these fields of specialization. A minimum of 48 quarter hours is required for the degree, 16 of which must be at the 400 level. Of these 16 hours, 12 must be in history courses. A student who has done graduate work in a recognized institution without receiving a degree may petition to receive credit by examination. A thesis is not required. The candidate must pass a reading examination in a foreign language relevant to his program of study. The language presented to meet this requirement must be approved by the department. For work in certain fields, a reading

knowledge of the particular language or languages relevant to that field may be required.* With the approval of the department a student may take a minor in another discipline.

The candidate must maintain an average of at least 4.00. Credit toward the degree will not be given for any course in which the student receives a grade of less than B.

*Students who expect to transfer to another school to continue graduate work beyond the M.A. are advised to check the foreign language requirements of that school.

The Master of Arts Program for Teachers

The Master of Arts in History includes a special program designed to meet the needs of high school and junior college teachers. It provides a wide exposure to history, an understanding of historical methodology and practice, and preparation in a field outside history. The program emphasizes the development of teaching strategies and instructional materials. A person who enters the program without professional certification for high school teaching may gain certification through additional work. Such arrangements must be made in advance. Part-time study is permitted in this program.

The candidate must present 48 hours of course work and pass written examinations in a major field and two minor fields. The major field may be selected from the following: the ancient world, medieval Europe, early modern Europe, modern Europe, Russia, Great Britain, Asia, Africa, United States, Latin America, or world history. The minor fields, one of which will ordinarily be taken outside the department, will be developed in consultation with an adviser. A candidate normally will take at least 12 hours in each of his fields. In addition, he must present 12 hours of work in a special colloquium in American, European, and world history. Candidates are required to take 12 hours in history at the 400 level. A thesis is not required. There is no language requirement. A student who has done graduate work in a recognized institution without receiving a degree may petition to receive credit for that work. The candidate must maintain an average of at least 4.00. Credit toward the degree will not be given for any course in which the student receives a grade of less than B.

Doctor of Philosophy

The department offers work leading to the doctorate in the fields of European and American history.

The doctorate in history indicates mastery of several general areas of historical knowledge and calls for an original contribution to scholarship

through independent study and research. Ordinarily, the candidate will complete a minimum of 48 quarter hours of graduate courses and seminars beyond the master's degree.

The requirement of the Graduate College for the doctorate is 96 quarter hours of work beyond the Master of Arts. A student may expect to enroll for approximately 48 quarter hours of thesis research.

Unless the candidate holds a Master of Arts from the University of Illinois at Chicago Circle or from an accredited institution and has been recommended for further advanced study, he will be expected to take a qualifying examination for the M.A. The candidate for the degree must also stand for oral and written preliminary examinations. Finally, he must present an acceptable dissertation and defend it in a final oral examination.

All new applicants for the Ph.D. at Chicago Circle will be evaluated by relevant professors after the completion of the first quarter. The department may require a student to take an oral examination at that time.

All Ph. D. candidates must have a reading knowledge of two foreign languages. In many fields of history command of a foreign language is indispensable for advanced study and research, and it is expected that that language will be used in course and seminar work as required. In some fields it is recognized that other tools, such as statistical theory, may be equally indispensable.

The program of study for each candidate will be fixed by the candidate and his adviser with the approval of the Graduate Advisory Committee of the Department of History.

Candidates must offer one major field of preparation and three minor fields, one of which may be outside the department, for the preliminary examinations. Two of the minor fields must be either geographically or chronologically outside the areas of his major field. The major fields of study offered by the department are: European history from 1450 to 1815, European history since 1648, American history from 1500 to 1877, American history since 1765, Russian history, British history since 1688, modern Italian history, and French history. Minor fields in European history are the Age of Enlightenment, diplomatic history since 1648, Bourbon France, revolutionary and Napoleonic France, Italy since 1789, intellectual history since 1815, Great Britain since 1837, imperialism and colonialism, historiography; in American history, the fields are economic history, Negro history, political parties, urban history, early national period, the Jacksonian Era, the Civil War and Reconstruction, the progressive era, and contemporary United States. Fields other than those listed may be accepted in individual cases. The work that a candidate may offer in other departments shall be determined in consultation with his adviser.

Urban Studies and Negro History. Graduate students will have an opportunity to pursue research in American urban studies and Negro history in the University's Urban History Manuscript Collection, a rich repository of

materials dealing with the social, economic, and political history of the United States and particularly with the history of the metropolitan Chicago area. Through the materials in this collection, students in history will be trained in the use of manuscripts as well as other primary materials employed in the study and writing of history.

Courses for Graduate and Advanced Undergraduate Students

Note: Graduate students must have background or training appropriate to the content of any 300-level course.

302. TOPICS IN GREEK HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of ancient history.

303. TOPICS IN ROMAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of ancient history.

306. TOPICS IN MEDIEVAL HISTORY. 4 HOURS. May be repeated for credit. Same as Religious Studies 306. Specific topics are announced each quarter. Prerequisite: 4 hours of medieval history.

309. TOPICS IN THE RENAISSANCE. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

311. TOPICS IN SIXTEENTH CENTURY EUROPEAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

312. TOPICS IN SEVENTEENTH CENTURY EUROPEAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

313. TOPICS IN EIGHTEENTH CENTURY EUROPEAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

314. TOPICS IN NINETEENTH CENTURY EUROPEAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

316. TOPICS IN TWENTIETH CENTURY EUROPEAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

318. TOPICS IN GERMAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

321. TOPICS IN BRITISH HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

324. TOPICS IN FRENCH HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

329. TOPICS IN ITALIAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

333. TOPICS IN EASTERN EUROPEAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

335. TOPICS IN RUSSIAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of European history.

341. TOPICS IN AFRICAN HISTORY. 4 HOURS. Study in depth of specific problems of internal African history, with concentration on such topics as the African role in the slave trade, the growth and decline of African states, African syntheses with European culture, or the African reaction to European domination and conquest. Prerequisite: 4 hours of African history.

351. TOPICS IN COLONIAL AMERICAN HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.

352. TOPICS IN REVOLUTIONARY AND EARLY NATIONAL UNITED STATES HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.

353. TOPICS IN NINETEENTH CENTURY UNITED STATES HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.

354. TOPICS IN TWENTIETH CENTURY UNITED STATES HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of United States history.

361. TOPICS IN LATIN AMERICAN HISTORY. 4 HOURS. May be repeated for credit. Same as Latin American Studies 361. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

380. TOPICS IN ECONOMIC HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of economic history.

386. TOPICS IN RACE, ETHNIC, AND MINORITY HISTORY. 4 HOURS. May be repeated for credit. Same as Black Studies 386. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

390. TOPICS IN DIPLOMATIC HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

391. TOPICS IN CONSTITUTIONAL HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

392. TOPICS IN INTELLECTUAL HISTORY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

393. TOPICS IN HISTORIOGRAPHY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

394. TOPICS IN FOLKLORE-HISTORY RELATIONS. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

395. TOPICS IN RELIGIOUS HISTORY. 4 HOURS. May be repeated for credit. Same as Religious Studies 395. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

396. TOPICS IN THE HISTORY OF SCIENCE. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

397. TOPICS IN THE HISTORY OF TECHNOLOGY. 4 HOURS. May be repeated for credit. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

Courses for Graduate Students

Note: Seminars are generally offered in two-quarter or three-quarter sequences. Several seminar sections are offered in European, American, and British research topics each year. Students may enroll in more than one section.

400. COLLOQUIUM FOR TEACHERS OF HISTORY. 4 HOURS. May be repeated for credit. Reading and discussion of significant primary and secondary sources; investigation and development of instructional materials and techniques. Prerequisite: Consent of the instructor.

402. SEMINAR ON ANCIENT HISTORY. 4 HOURS. May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section is permitted for a maximum of 16 hours per quarter.

408. SEMINAR ON MEDIEVAL HISTORY. 4 HOURS.

410. SEMINAR ON RENAISSANCE HISTORY. 4 HOURS.

411. COLLOQUIUM ON EUROPEAN HISTORY. 4 HOURS. Reading in topics in European history. Prerequisite: Consent of the instructor.

412.   SEMINAR ON EUROPEAN HISTORY. 4 HOURS.

421.   COLLOQUIUM ON BRITISH HISTORY. 4 HOURS. Reading in topics in British history. Prerequisite: Consent of the instructor.

422.   SEMINAR ON BRITISH HISTORY. 4 HOURS. May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section is permitted for a maximum of 16 hours per quarter.

431.   COLLOQUIUM ON RUSSIAN HISTORY. 4 HOURS. Reading in topics in Russian history. Prerequisite: Consent of the instructor.

432.   SEMINAR ON RUSSIAN HISTORY. 4 HOURS.

441.   COLLOQUIUM ON AFRICAN HISTORY. 4 HOURS. May be repeated for credit. Introduction to the literature of African history. Prerequisite: 8 hours of African history.

442.   SEMINAR ON AFRICAN HISTORY. 4 HOURS. May be repeated for credit.

451.   COLLOQUIUM ON AMERICAN HISTORY. 4 HOURS. Reading in topics in American history. Prerequisite: Consent of the instructor.

452.   SEMINAR ON AMERICAN HISTORY. 4 HOURS. May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section is permitted for a maximum of 16 hours per quarter.

461.   SEMINAR ON LATIN AMERICAN HISTORY. 4 HOURS.

479.   SEMINAR: THEORETICAL, HISTORICAL, AND PHILOSOPHICAL ISSUES IN PSYCHOLOGY. 2 HOURS. May be repeated. Same as Philosophy 479 and Psychology 479. Systematic review of special topics; emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.

489.   SEMINAR ON URBAN HISTORY. 4 HOURS.

492.   HISTORIOGRAPHY. 4 HOURS. Great historians from early times to the present.

493.   HISTORICAL METHODS. 4 HOURS. A laboratory course to provide an understanding of the study of history and practical application of the methods by which the past is reconstructed.

497.   RESEARCH AND WRITING. 0 TO 12 HOURS. Special problems in research and individual guidance in the preparation of master's research essays.

498.   INDEPENDENT STUDY. 0 TO 12 HOURS.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit.

INFORMATION ENGINEERING

Professors: Bruce H. McCormick, Head of the Department; Robert C. Arzbaecher, Earl E. Gose, Philip Parzen, Chathilingath K. Sanathanan

Associate Professors: Glenn K. Manacher, Tadao Murata, Piergiorgio L. E. Uslenghi, Bert L. Zuber

Assistant Professors: Yun-Leei Chiou, Roger C. Conant, Rucelle L. Consigny, Robert A. Dell, John D. Ferguson, Hitoshi Inada, Philip L. Katz, Sharadbabu R. Laxpati, Bernard J. Nordmann, Jr. (Adjunct), Miljenko Orsic, Ronald Priemer, John L. Semmlow, Stephen Tsai

The department offers a program leading to the Master of Science in Information Engineering and, with the Department of Electrical Engineering at Urbana, an intercampus program leading to the Doctor of Philosophy.

Admission Requirements

Applicants should have a grade-point average of B (4.00) or better for the last 90 quarter hours of undergraduate work. However, applicants with grade-point averages between 3.50 and 4.00 may be admitted upon special recommendation of the department. Practicing engineers who wish to return to school for further graduate instruction may be admitted tentatively if their professional experience indicates that they will probably succeed in the program. Tentative admission becomes permanent after the completion of at least 16 quarter hours with a grade-point average of 4.00 or better.

Master of Science

Specialization in information engineering allows a broad choice of topics in the electrical, computer, and information sciences, and in engineering. The choice of topics includes solid state electronics, circuits and signal processing, electromagnetic fields, communication networks, automatic control systems, and computer science. This program is offered for graduates of information and systems engineering-oriented curricula at the University of Illinois at Chicago Circle and for graduates of electrical engineering, computer science, or similar curricula elsewhere. Graduates of other scientifically oriented curricula may be admitted if they have the background to profit from graduate work in this field.

Degree Requirements

A grade-point average of at least 4.00 is required for the Master of Science. Credit is not given for a course in which the grade is less than C. For the degree 48 quarter hours and these minimum requirements:

The successful completion of a thesis, research project, design project, or extensive reading assignment to be followed by a written report and an oral examination, for which the student will receive credit for at least 4 and not more than 16 quarter hours.

The completion of at least 20 quarter hours (including thesis credit) in information engineering courses at the 400 level, including three courses chosen from at least two areas of specialization; typical examples of such areas are: Information Engineering 410, 412, 415; Information Engineering 430; Information Engineering 420, 440; Information Engineering 460, 461, 462, 463; Information Engineering 470, 471, 472.

Courses for Graduate and Advanced Undergraduate Students

307. CYBERNETICS I. 4 HOURS. Same as Systems Engineering 307. Introduction to artificial intelligence and pattern recognition by computer. Programs for playing games, proving theorems, answering questions, and making medical diagnoses. Property selection and decision making techniques. Prerequisites: Math. 195 and either 250 or 370.

311. LINEAR SYSTEMS ANALYSIS. 4 HOURS. No graduate credit for majors in information engineering. Application of signal representations discussed in Information Engineering 212 to the analysis of linear systems; transform methods and frequency analysis; natural response and stability; signal flow graphs; Laplace transform with two variables; convolution integral and applications. Prerequisite: InfE. 212.

312. INTRODUCTION TO COMMUNICATION ENGINEERING. 4 HOURS. Introduction to communication systems: amplitude, frequency, and pulse-type modulation, time and frequency multiplexing, noise calculations and signal to noise ratio. Prerequisites: InfE. 311 and 340 or SysE. 315.

315. INTERMEDIATE NETWORK ANALYSIS. 4 HOURS. Network theorems; introduction to topological approaches in general linear network analysis; loop, node, and state variable equations; network functions; the positive and real concept. Prerequisite: InfE. 311.

316. INTRODUCTION TO NETWORK SYNTHESIS. 4 HOURS. Continues Information Engineering 315. Positive real functions, L-C synthesis, RC, RL, and RLC synthesis, and filter design. Individual projects are required. Prerequisite: InfE. 315.

320. FIELDS AND WAVES III. 4 HOURS. Transmission line equations. Transient phenomena; time-harmonic waves. Nonelectromagnetic waves. Scattering matrix and applications. Prerequisite: InfE. 221.

324. PRINCIPLES OF MICROWAVES. 4 HOURS. Analysis of guided waves. Rectangular and circular cylindrical waveguides. Coaxial lines. Dielectric rod microwave devices. Microwave network theory. Prerequisite: InfE. 320.

325.   ANTENNA ENGINEERING AND WAVE PROPAGATION. 4 HOURS. Radiation from current elements. Scalar and vector formulation for radiation and scattering. Theorems of antenna analysis. Antenna impedance. Arrays. Prerequisite: InfE. 320.

326.   MICROWAVE SEMICONDUCTOR ELECTRONICS. 4 HOURS. Varactor diodes, parametric devices, and harmonic generators. Tunnel, IMPATT, and Gunn diodes, with applications. Prerequisites: InfE. 320 and 346.

327.   MODERN LINEAR OPTICS. 4 HOURS. Two-dimensional Fourier analysis, linear invariant sytems, sampling theory. Applications of transfer functions to scalar diffraction, gratings, and lenses. Frequency analysis of imaging systems. Spatial filtering and optical information processing. Holography and its applications. Prerequisites: InfE. 212 and 221.

330.   COMMUNICATION THEORY I. 4 HOURS. With Information Engineering 331, an introduction to statistical communication theory. Signal spectra, modulation, noise, probability theory; applications of statistics to communication systems. Prerequisite: InfE. 312.

331.   COMMUNICATION THEORY II. 4 HOURS. Continues Information Engineering 330. Individual projects are required. Prerequisite: InfE. 330.

340.   ELECTRONIC CIRCUITS. 4 HOURS. Analysis and design of analog and digital electronic circuits; basic circuit properties, linear amplifiers, stability, operational and multistage configurations, tuned amplifiers and oscillators. Practical laboratory experience. Prerequisites: InfE. 240, 311, and Math. 195.

344.   ELECTRONIC SWITCHING, TIMING, AND PULSE CIRCUITS. 4 HOURS. Analysis of piecewise linear active networks; single time constant circuit evaluation; semiconductor devices as switching elements; clamping, coupling, regenerative switching, and linear sweep circuits; pulse transformers; negative-resistance devices. Prerequisites: InfE. 212 and 340.

345.   INTEGRATED CIRCUIT APPLICATIONS AND SYSTEMS. 4 HOURS. Components in integrated circuits; digital integrated circuit families; linear wideband, differential, operational, and power amplifiers; operational amplifier design, analysis, and switching circuit applications; communication and data conversion circuits; digital information storage. Prerequisite: InfE. 344.

346.   SEMICONDUCTOR ELECTRONICS. 4 HOURS. Electron and hole transport mechanisms in semiconductor devices; quantum approach to distributions and statistics, recombination and generation, p-n junctions, and transistors; practical laboratory experience. Prerequisites: InfE. 240 and credit or registration in Phys. 114.

347.   THIN FILM DEVICES. 4 HOURS. Introduction to vacuum technology. Methods of fabrication of films, sputtering, evaporation, electron beam evaporation, and chemical deposition. Physical properties of films. Application of films. Resistor, capacitor, transistor, diode, magnetic memory devices, and superconductors. Prerequisites: InfE. 340 and 346.

348. FIELD EFFECT DEVICES. 4 HOURS. Electronic processes in surface-controlled semiconductor and dielectric devices. Properties of MIS field effect capacitors and transistors, surface and interface effects, and fabrication techniques. Prerequisites: MatE. 230, InfE. 340 and 346.

350. PROSTHESES AND ARTIFICIAL ORGANS. 4 HOURS. The special problems encountered in the design of organ replacements as engineering devices. Sub-organ replacements, circulatory assist devices, artificial kidneys, and other organ systems. Prerequisites: InfE. 200, 383, 384, MatE. 230, and EnrE. 211 or the equivalents.

352. BIOCONTROL. 3 HOURS. Demonstration of the applicability of control systems theory to physiological systems, including the pupil system, eye and hand movement systems, by utilizing such techniques as Fourier analysis, Nyquist stability criteria, and cross-correlation. Prerequisites: InfE. 311 and 383 or 384.

353. BIOCONTROL LABORATORY. 3 HOURS. Experimental counterpart of Information Engineering 352. Motor coordination, crayfish photoreceptor, human pupil, eye movement. Prerequisite: Credit or registration in InfE. 352.

354. BIOINSTRUMENTATION: TRANSDUCERS. 4 HOURS. Consideration of energy conversion; detailed discussion of transducers used in biological research. Prerequisites: InfE. 240 and 311.

355. ENGINEERING BIOPHYSICS. 4 HOURS. Introduction to biophysical mechanisms at the molecular, cellular, and organ levels. Passive and active properties of excitable tissue; quantitative descriptions and modeling of biophysical mechanisms; cell-to-cell transmission and ionic mechanisms. Prerequisites: Math. 220, Phys. 231, and any two of InfE. 100, 101, 102.

356. MATERIALS IN BIOENGINEERING. 4 HOURS. Analysis of materials problems associated with prostheses and other implanted devices (medical and dental). Prerequisites: MatE. 230 and InfE. 383 or 383.

359. NEUROANATOMY. 5 HOURS. Same as Biological Sciences 359. Introduction to the neurological organization of the mammalian central nervous system. Prerequisites: BioS. 280 and consent of the instructor.

360. AUTOMATIC CONTROL THEORY I. 4 HOURS. Introductory mathematical preliminaries of control systems. Concept of feedback; transfer functions of typical electrical, mechanical, and hydraulic control systems; state variable representation of systems; signal flow graphs; implications of feedback on system performance; time domain analysis; stability concepts including Lyapunov, Routh-Hurwitz, and Nyquist stability criteria. Laboratory assignments include experimental determination of the response of typical control systems and analog computer simulations. Prerequisite: InfE. 311 or SysE. 315.

361. AUTOMATIC CONTROL THEORY II. 4 HOURS. Continues Information Engineering 360. Introduction to the design of feedback control systems, frequency response methods, root locus, Nichols chart, compensation techniques;

modern control theory, matrix representation of linear systems and mode interpretations, concepts of controllability and observability; and linear time-varying systems. Projects involving studies on servo systems and extensive simulations on digital or analog computers. Prerequisite: InfE. 360.

371. SWITCHING NETWORKS AND LOGICAL DESIGN. 4 HOURS. A background of basic concepts common to digital systems. Coding and representation of information, nondecimal number systems, switching algebra, combinational logic, electronic implementation and representation of logic, minimization techniques, analysis and synthesis of asynchronous and synchronous sequential networks, error correcting codes, hazards and races due to logical circuit delays. Prerequisite: Math. 195.

372. DESIGN OF DIGITAL SYSTEMS. 4 HOURS. Introduction to hardware design techniques, diode matrices, transistor circuits, storage elements, registers, adders, counters. Design philosophy, functional units and layout of digital computers, arithmetic and control operations. Prerequisite: InfE. 371.

373. COMPUTER ORGANIZATION AND ARCHITECTURE. 3 HOURS. Evolution of design concepts into system organization and hardware-software integration. Memory and input-output units, channel controllers, interrupt concepts, cycle stealing, examples of general purpose computer organization. Hardware-software tradeoffs. Introduction to machine languages, assemblers, and loaders. Prerequisite: InfE. 372.

379. REAL-TIME DATA PROCESSING. 4 HOURS. Theory and techniques of data processing using analog and digital computers. Emphasis on the unique computational problems presented by biological data, illustrating the practical use of communication theory. Prerequisites: Math. 195 and 220.

383. ANIMAL PHYSIOLOGY I. 5 HOURS. Same as Biological Sciences 363. The role of the digestive, circulatory, respiratory, and osmoexcretory systems in the maintenance of organismic homeostasis. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: InfE. 284.

384. ANIMAL PHYSIOLOGY II. 5 HOURS. Same as Biological Sciences 364. The role of the muscular, sensory, nervous, and endocrine systems in the maintenance of organismic integration. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: InfE. 284.

391. SEMINAR. 1 TO 4 HOURS. Topics to be arranged. Prerequisite: Senior standing.

393. SPECIAL PROBLEMS. 2 TO 4 HOURS. May be repeated for credit. Special problems or reading by arrangement with the faculty. Prerequisite: Senior standing.

396. SENIOR DESIGN I. 4 HOURS. Same as Energy Engineering 396, Materials Engineering 396, and Systems Engineering 396. Introduction to engineering economics, legal and social constraints on design, safety and reliability theory, and the use of simulation and optimization techniques in the engineering design process. Prerequisite: Senior standing in the College of Engineering.

397.   SENIOR DESIGN II. 4 HOURS. Same as Energy Engineering 397, Materials Engineering 397, and Systems Engineering 397. Application of principles of engineering and engineering design methodology to the solution of a large-scale design problem. May be taken in any department, regardless of area of concentration. Prerequisite: InfE. 396.

Courses for Graduate Students

408.   CYBERNETICS II. 4 HOURS. Comparison of natural and artificial intelligence and pattern recognition. Information processing in nets. Image processing. Models of retinal and brain structure, thought, learning, and memory. Prerequisite: InfE. 307.

409.   PATTERN RECOGNITION TECHNIQUES AND SYSTEMS. 4 HOURS. Functions and systems of functions, such as machines designed to learn the common properties of a set of N-dimensional vectors of patterns representing samples of a class and to recognize a new vector as a possible member of the class by noting properties common to the set of sample vectors. Prerequisites: SysE. 372 and 451 or InfE. 307.

410.   ADVANCED LINEAR ANALYSIS. 4 HOURS. Analysis of linear networks and systems in the time and frequency domains. Basis of loop and node equations. Signal flow graphs, transform methods, state variable representation, stability. Prerequisites: InfE. 311 and credit or registration in Math. 330.

412.   PASSIVE NETWORK SYNTHESIS. 4 HOURS. Review of driving point synthesis. Various techniques of transfer function synthesis. The approximation problem for frequency and time domain synthesis. Modern filter design. Prerequisites: InfE. 316 or consent of the instructor and credit or registration in Math. 330.

413.   ACTIVE NETWORK SYNTHESIS. 4 HOURS. Linear active and nonreciprocal network synthesis. Realizations involving negative resistances, controlled sources, negative immittance convertors, gyrators, and operational amplifiers. Sensitivity considerations. Application to active integrated circuit synthesis. Prerequisite: InfE. 316.

414.   ADVANCED TOPICS IN NETWORK THEORY. 4 HOURS. Selection from such topics as linear multiport network synthesis, scattering matrix synthesis, analysis and design of distributed parameter networks, nonlinear and time-varying circuit theory, and digital filters. Prerequisite: InfE. 410 or 412.

415.   NETWORK TOPOLOGY. 4 HOURS. Network theoretic graph theory. Tree, cutset, path, circuit, and incidence matrices and their properties. Topological formulae for passive and active network analysis. Topological analysis and synthesis of switching circuits. Applications to transportation and communication networks. Flow-graph techniques of linear system analysis. Prerequisite: InfE. 315.

420.   ELECTROMAGNETIC FIELD THEORY. 4 HOURS. Transmission lines, guided waves, radiation from antennas. Prerequisites: InfE. 324 and credit or registration in Math. 330.

421. ADVANCED ELECTROMAGNETIC FIELD THEORY. 4 HOURS. Advanced study of electromagnetic field concepts, including uniqueness and reciprocity theorems, Huyghen's and Babinet's principles, reaction concept, variational methods, and applications to several coordinate systems. Prerequisite: InfE. 420.

422. ADVANCED MICROWAVE THEORY. 4 HOURS. General solution for fields in waveguides of arbitrary cross section. Microwave network analysis. Microwave devices, microwave cavities, and microwave filters. Prerequisite: InfE. 420.

423. ANTENNA THEORY AND DESIGN. 4 HOURS. Theory and design of antennas and radiating systems. Analysis of linear, circular, and helical radiation elements. Reciprocity theorems. Antenna arrays. Slot, horn, and reflector type antennas. Prerequisites: InfE. 325 and 420.

427. OPTICAL ELECTRONICS. 4 HOURS. Waves, rays, and gaussian beams in various media. Optical resonators. Interaction of radiation and atomic systems. Theory of laser oscillation. Solid, gas, and semiconductor lasers. Nonlinear optical phenomena. Optical radiation: modulation, detection, and noise. Optical communication systems. Prerequisites: InfE. 327 and 420 or the equivalents.

430. ADVANCED COMMUNICATION THEORY I. 4 HOURS. Beginning graduate course in modern communication theory. Review of probability theory, random waveforms, optimum receiver principle. Prerequisite: InfE. 331.

431. ADVANCED COMMUNICATION THEORY II. 4 HOURS. Continues Information Engineering 430. Efficient signaling for message sequences and implementation of coded systems. Prerequisite: InfE. 430.

432. ADVANCED COMMUNICATION THEORY III. 4 HOURS. Continues Information Engineering 431. Channel models, filter-signal channel, bandpass channel, fading channel. Linear modulation, twisted modulation, frequency modulation, channel capacity, pulse-code modulation. Prerequisite: InfE. 431.

439. SEMINAR IN BEHAVIOR AND INFORMATION THEORY. 3 HOURS. Topics in the application of information theory to behavior; emphasis on infra-human behavior. Prerequisite: Math. 370 or InfE. 408 or Psch. 470.

440. SOLID STATE DEVICE THEORY I. 4 HOURS. Study of electrical phenomena in solids, using quantum mechanics. Semiconductors. p-n junctions, transitors. Hall effect, thermal and optical effects. Prerequisites: InfE. 342 and Phys. 321.

441. INTEGRATED SOLID STATE DEVICES. 4 HOURS. Applications of solid state theory to modern integrated circuits. Active and passive semiconductors, active and passive functional blocks, MOS and thin film devices. Prerequisites: InfE. 316 and 440.

442. SOLID STATE DEVICE THEORY II. 4 HOURS. Tunnel, Gunn, and IMPATT diodes, insulator diodes, carrier traveling wave effects in semiconductors. Prerequisites: InfE. 440 and credit or registration in InfE. 420.

451. ADVANCED BIOCONTROL. 3 HOURS. Mathematical modeling and analysis of biological systems, emphasizing techniques of control engineering. Prerequisite: InfE. 353.

452. ADVANCED BIOCONTROL LABORATORY. 3 HOURS. Laboratory experiments in conjunction with Information Engineering 451. Experience with control systems of pupil, eye movement, sensory motor coordination. Prerequisite: Credit or registration in InfE. 451.

453. ADVANCED SYSTEMS PHYSIOLOGY. 3 HOURS. Intensive treatment of selected neurophysiological topics; emphasis on systems organization. Prerequisite: InfE. 353.

454. ADVANCED SYSTEMS PHYSIOLOGY LABORATORY. 2 HOURS. Coding in the frog's retina using microelectrode techniques. Prerequisite: InfE. 453.

457. ANALYSIS OF VISUAL SYSTEMS. 4 HOURS. An advanced course covering in detail important research areas of the visual system. The fundamental importance of physical, chemical, and physiological processes as related to vision is stressed. Prerequisite: Consent of the instructor.

460. ADVANCED CONTROL THEORY. 4 HOURS. Analysis of multivariable, multiloop control systems. Advanced topics in state space, time varying and distributed parameter systems, stability, controllability, and observability. Introduction to adaptive control. Various computer applications. Prerequisite: InfE. 361.

461. NONLINEAR CONTROL. 4 HOURS. Classification of nonlinear phenomena, linear and piecewise linear approximations. The describing function and on-off servomechanisms, phase plane techniques, limit cycle, stability concepts. Use of analog, digital, and hybrid computers for simulation. Prerequisite: InfE. 361.

462. SYNTHESIS TECHNIQUES IN LINEAR CONTROL. 4 HOURS. Design principles. Cascade compensation using root locus, polar and log plots, feedback compensation. Applications in electrical, electromechanical, and fluid control. Mitrovic's parameter plane methods. Prerequisite: InfE. 361.

463. STATISTICAL AND SAMPLED DATA CONTROL. 4 HOURS. Basic principles of statistical design; random signals in a control system; properties of correlation function; optimality. Wiener-Hopf equation. Design of systems with constraints. Introduction to sampled data control; the sampling process; Z transform methods; stability, time and frequency response, compensation techniques. Prerequisites: InfE. 330 and 361.

470. AUTOMATA THEORY. 4 HOURS. Definition and representation, equivalent states, congruence relations, decision problems of finite automata, the halting problem, state assignment problem, partitions, growing automata, probabilistic automata, self-repairing and self-reproducing systems. Prerequisite: InfE. 373.

471. ADVANCED SWITCHING THEORY. 4 HOURS. Principles of sequential circuit synthesis, structure of combinational switching circuits, the covering problem,

multiple output and multilevel combinational circuits, bilateral switching networks, speed independent switching circuit theory. Prerequisite: InfE. 373.

472. HYBRID COMPUTATION THEORY AND TECHNIQUES. 4 HOURS. Basic characteristics of analog and digital computers, nature of problems best suited for analog, digital, and hybrid computers, organization of a hybrid computer, analog digital conversion, hybrid computing techniques with examples from different disciplines. Prerequisite: InfE. 373.

484. BIOINSTRUMENTATION: SYSTEMS. 3 HOURS. Analysis of systems used in biological and medical instrumentation. General principles and specific electrical, mechanical, and optical aspects of instrumentation systems.

491. SEMINAR. 1 TO 4 HOURS. Topics to be arranged. Prerequisite: Consent of the instructor.

495. INDIVIDUAL RESEARCH. 2 TO 4 HOURS. May be repeated. Research on special problems not included in graduate thesis. Prerequisite: Consent of the instructor.

498. SEMINAR IN BIOENGINEERING. 1 TO 4 HOURS. May be repeated. Systematic review of special topics; emphasis on current research. Prerequisite: Consent of the instructor.

499. GRADUATE RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Thesis work under the supervision of a graduate adviser.

LINGUISTICS PROGRAM

Professors: Andrew Schiller, Director; Michael A.K. Halliday, Falk S. Johnson

Associate Professors: Adam Makkai, Valerie B. Makkai

Assistant Professors: Edward J. Stone, Dale E. Woolley

The program in linguistics offers work leading to the Master of Arts in two fields of concentration: applied linguistics, primarily for teachers of English and other languages at the secondary level, and theoretical linguistics, which prepares students to become professional linguists on the doctoral level. The student will select his field of concentration in consultation with the program director. Degree requirements are the same for each field.

Admission Requirements

Applicants must hold a baccalaureate from an accredited college or university and must have an overall grade-point average of 4.00 (A=5.00) for

the last 90 quarter (60 semester) hours of undergraduate study.

Applicants must submit the following, unless exempted:

1. Three letters of recommendation, preferably from professors who are familiar with the applicant's recent work.
2. A statement of about 250 words presenting the applicant's reasons for wishing to do graduate work in linguistics and the relationship of his work to his professional and other goals.
3. Graduate Record Examination (GRE) score for the general aptitude test. It is recommended that he also submit scores for his own special field. Ordinarily, the acceptable minimum scores on these tests are at the 60th percentile.

A foreign applicant should submit GRE scores if it is possible for him to take the examination; otherwise, he may be admitted on a limited status and will be required to take the examination in his first quarter in residence. He is also required to submit a four to five page summary of his educational experience, emphasizing his work in English and other literatures and languages, concluding with a statement of his reasons for wanting to do graduate work in the United States. This replaces the 250 word statement required of other applicants.

Degree Requirements

Hours: A minimum of 48 quarter hours of course work is required, including Linguistics 315, Introduction to Descriptive Linguistics, and English 400, Introduction to Bibliography and Research (in a section for linguistics students). If the student has not had a course in the history of the English language, he may be required to take English 300.

Language: The student must pass a reading examination in two foreign languages, which may be other than classical and modern European.

Thesis: The student is required to submit a thesis. He may register for up to 12 hours of thesis research.

Examination: The student must pass a comprehensive examination.

Courses for Graduate and Advanced Undergraduate Students

305. INTRODUCTION TO LINGUISTICS. 4 HOURS. Introduction to the theories and methods of the phonological, morphological, and syntactic analysis of language. Prerequisite: Junior standing.

307. HISTORY OF LINGUISTIC SCIENCE. 4 HOURS. Development of linguistic thought from its historical beginnings to the present. Prerequisite: Ling. 305 or junior standing and consent of the instructor.

310. PHONETICS AND PHONEMICS. 4 HOURS. Introduction to articulatory phonetics and phonemic analysis. Practice in transcription of utterances from English and other languages. Prerequisite: Ling. 305 or junior standing and consent of the instructor.

320. MORPHOLOGY. 4 HOURS. Introduction to the theories and methods of morphological analysis. Prerequisite: Ling. 310 or junior standing and consent of the instructor.

330. SYNTAX. 4 HOURS. Introduction to the theories and methods of syntactic analysis. Prerequisite: Ling. 320 or junior standing and consent of the instructor.

340. COMPARATIVE AND HISTORICAL LINGUISTICS. 4 HOURS. The comparative and diachronic study of languages. Prerequisite: Ling. 310 or junior standing and consent of the instructor.

352. APPLIED LINGUISTICS. 4 HOURS. Study of a selected topic, such as the problems of literary style, rhetoric, metrics, or the construction of pedagogical grammars. Content varies. Prerequisite: Ling. 305 or junior standing and consent of the instructor.

353. DIALECTOLOGY. 4 HOURS. Geographical and social variations in languages. Prerequisite: Ling. 310 or junior standing and consent of the instructor.

356. FIELD METHODS IN LINGUISTICS. 4 HOURS. The description of a language using data by native speakers. Prerequisite: Ling. 310 or junior standing and consent of the instructor.

357. SYSTEMIC AND FUNCTIONAL DESCRIPTION OF MODERN ENGLISH I. 4 HOURS. An introductory scientific description; emphasis on surface structure. Prerequisite: Ling. 305.

358. SYSTEMIC AND FUNCTIONAL DESCRIPTION OF MODERN ENGLISH II. 4 HOURS. Advanced scientific description; emphasis on meaning and social codes. Prerequisite: Ling. 357.

359. TOPICS IN LINGUISTICS. 4 HOURS. May be repeated for a maximum of 12 hours. Topics vary. Prerequisite: Consent of the instructor.

374. THE PSYCHOLOGY OF LANGUAGE. 4 HOURS. Same as Psychology 354 and Speech and Theater 354. Introductory survey of methods, theory, and research; the history and present status of psychology's interest in language behavior. Prerequisite: Consent of the instructor.

380. PROBLEMS IN LINGUISTIC ANALYSIS. 4 HOURS. Same as Anthropology 380. Examination of the methods and techniques used in linguistics, with reference to actual language data; emphasis on anthropological applications. Prerequisite: Anth. 280 or Ling. 305.

Courses for Graduate Students

445. INTRODUCTION TO INDO-EUROPEAN STUDIES. 4 HOURS. Prerequisites: A

453.   LANGUAGE TYPOLOGY. 4 HOURS. Theories and methods of the classification of languages. Prerequisite: Ling. 330 or the equivalent.

454.   LINGUISTICS AND LANGUAGE LEARNING. 4 HOURS. Applications of linguistic science to the teaching of foreign languages. Prerequisite: Ling. 330 or the equivalent.

457.   SEMANTICS. 4 HOURS. The study of meaning. Prerequisite: Ling. 330 or the equivalent.

459.   SEMINAR ON LINGUISTICS. 4 HOURS. May be repeated for a maximum of 12 hours. Topics vary. Prerequisite: Consent of the instructor.

471.   EXPERIMENTAL PSYCHOLINGUISTICS. 4 HOURS. Same as Psychology 401 and Speech and Theater 401. Intensive review of experimental laboratory studies concerned with the effects of phonological, syntactic, and semantic variables on sentence perception, comprehension, production, and memory in the mature language user. The relevance of the research in contemporary psycholinguistic theory is emphasized. Prerequisites: Ling. 374 or the equivalent and consent of the instructor.

472.   DEVELOPMENTAL PSYCHOLINGUISTICS. 4 HOURS. Same as Psychology 427. Theoretical formulation, research methods, and research findings in the area of language development. Biological foundations and environmental influences; disorders of language development. Prerequisite: Ling. 374.

480.   SEMINAR IN SOCIOLINGUISTICS. 4 HOURS. Same as Anthropology 480. Past and current approaches to sociolinguistics; variations of linguistic structure with social structure among different linguistic groups. Prerequisite: Ling. 380.

MATERIALS ENGINEERING

Professors: Ernest F. Masur, Head of the Department; Thomas H. Blewitt, Robert F. Domagala, James M. Doyle, Jorge O. Galante (Adjunct Research Professor), Gordon H. Geiger, David W. Levinson, William Rostoker, John A. Schey, Albert B. Schultz, Thomas C.T. Ting

Associate Professors: Donald G. Lemke, Paul E. Mast (Adjunct), Daniel F. Schoeberle, Surendra P. Shah, Charles A. Timko (Adjunct), Otto E. Widera, Chien H. Wu

Assistant Professors: Ted B. Belytschko, Graham M. Brown, Robert H. Bryant, Lawrence E. Carlson, Marshall L. Silver, Fred A. Webster, Michael J. Weins

    The department offers a program leading to the Master of Science in Mechanics and Materials. Jointly with the Department of Energy Engineering it offers a program leading to the Doctor of Philosophy in Engineering (Solids

The M.S. program covers a broad range of topics and may be used either as a terminal program or as a basis for further studies. The courses offered are relevant to many professional disciplines. Because of extensive freedom in course selection, a student may prepare himself for a career in such diverse areas of concentration as metallurgy, soil mechanics and foundations, structures (including concrete technology), engineering mechanics (including machine mechanics and biomechanics), and environmental mechanics and materials. Interdisciplinary and interdepartmental programs are permitted and encouraged, especially in the biological and environmental disciplines.

The student selects a departmental adviser with whom a tentative course program is planned. Both program and adviser may be changed at any time to suit the student's needs and preferences; however, satisfaction of the departmental degree requirements must be verified by the department.

To aid the student in planning his initial program, the following courses offered by the Department of Materials Engineering are listed according to their disciplinary relevance. For possible program and course combinations and for information on new course offerings the special departmental brochures and bulletins should be consulted.

Metallurgy—Materials Engineering 331, 332, 333, 334, 335, 337, 338, 360, 361, 362, 363, 364, 384, 432, 433, 434, 461, 462, 463, 465, 466, 467

Soil Mechanics and Foundations—Materials Engineering 344, 345, 346, 370, 371, 372, 373, 434, 441, 442, 447

Structures— Materials Engineering 302, 321, 322, 324, 325, 326, 402, 406, 411, 421, 422, 423, 424, 425

Mechanics— Materials Engineering 302, 303, 304, 308, 309, 311, 312, 313, 316, 333, 360, 361, 383, 402, 403, 404, 406, 408, 409, 411, 412, 413, 414, 415, 416, 419, 420, 433, 461, 462, 463

Environmental Mechanics and Materials—Materials Engineering 302, 304, 308, 311, 312, 313, 321, 322, 333, 334, 338, 370, 381, 383, 411, 412, 413, 421, 425, 463

In the environmental mechanics and materials areas the student is expected to supplement his program with relevant course offerings in the Departments of Energy Engineering and Systems Engineering and in the School of Public Health of the University of Illinois at the Medical Center.

The joint Ph.D. program includes several areas of specialization, of which the Department of Materials Engineering covers the fields of continuum mechanics, metallurgy, soil engineering, and structures. Students are permitted and encouraged to follow interdisciplinary programs that include more than one area of specialization and may require taking courses in more than one department.

Admission Requirements

Graduates from recognized engineering colleges will be admitted if they have maintained a grade-point average of B (4.00) or better in undergraduate study. Those with lower averages may be admitted upon recommendation of the department, providing they satisfy the minimum requirements of the Graduate College. Practicing engineers who wish to return to school for graduate instruction may be admitted on limited status if their professional experience indicates that they probably will be able to follow the program successfully. Limited admission will become permanent after the completion of at least 16 quarter hours with an average of 4.00 or better.

Degree Requirements

A grade-point average of at least 4.00 is required. Credit toward a graduate degree is not given for any course in which a grade of less than C has been obtained.

Master of Science

Of the required 48 quarter hours at least 16 must be in 400-level courses. Because of the diversity of the department offerings and areas of concentration specific courses are not prescribed; however, to insure adequate breadth, the student must complete at least two courses outside his immediate area of concentration.

Unless he is enrolled in the metallurgy or environmental mechanics and materials areas of concentration in which a thesis *is* required, the student may, at his discretion and in consultation with his adviser, elect up to 12 hours of Materials Engineering 499, Thesis Research. To obtain this credit he must submit and defend a thesis before an examining committee. However, of these 12 hours only 8 hours may be used to satisfy the 400-level course requirement.

Doctor of Philosophy

To become a candidate for the doctorate a student must pass a departmental qualifying examination to be taken within one quarter of the completion of the requirements for an M.S. If the student has an M.S. from another institution, he must take his qualifying examination within two quarters of his admission as a graduate student. It may be retaken once if so recommended by the examination committee.

Approximately 48 quarter hours of course work beyond the M.S. (or the equivalent) are required. While there are no specific course requirements, two courses must be taken in the Department of Energy Engineering. Toward the end of his course work, the student is required to pass a preliminary examination administered by a faculty committee.

A major requirement of the Ph.D. program is the completion of a thesis based on original research, which is carried out and the thesis written under the supervision of a faculty committee of at least five members. The thesis must be defended before the committee and the public in an examination, notice of which appears in an official campus publication.

The number of credit hours required for the doctoral thesis is flexible and is adjustable in accordance with the regulations of the Graduate College. Although formal thesis research often does not start until completion of the preliminary examination requirements, it is also common to initiate an informal research program while the student is still involved in course work.

Foreign language proficiency is not required.

Courses for Graduate and Advanced Undergraduate Students

302. APPLIED ELASTICITY I. 4 HOURS. Variational theorems of elasticity theory. Application to establishment and solution of approximate systems; beams (including shear deformations) and plates. Introduction to instability theory. Prerequisite: MatE. 205 or 206.

303. THEORY OF ELASTICITY I. 4 HOURS. The boundary value problems of linear isotropic elasticity theory. Uniqueness of solution. Reduction to two dimensions: the plane problem, torsion, bending. General orthogonal coordinates and special application to polar coordinates. Three-dimensional problems with axial symmetry. Prerequisite: MatE. 316.

304. EXPERIMENTAL STRESS ANALYSIS. 4 HOURS. Structural similitude and dimensional analysis. Brittle coating. Introduction to photoelasticity. Strain measurement techniques. Prerequisite: MatE. 206.

308. INTERMEDIATE VIBRATION THEORY. 4 HOURS. Analytical and numerical treatment of vibrations induced in n-degree of freedom linear discrete systems by periodic, shock, and random excitation. Prerequisite: MatE. 208.

309. ANALYSIS AND SYNTHESIS OF MECHANISMS II. 4 HOURS. Advanced techniques for the analysis and synthesis of motion. Emphasis on planar mechanisms. Roberts-Chebyschev theorem, Euler-Savary equation. Type, number, and dimensional synthesis. Geometric and algebraic techniques. Applications, computational methods. Prerequisite: MatE. 209.

311. INTERMEDIATE DYNAMICS. 4 HOURS. Kinematics of a point; space curves. Particle dynamics, orbital motion, and stability. Moving reference frames. Rigid

body dynamics; the inertia tensor, Euler's equations, application to gyroscopic motion. Hamilton's principle. Generalized coordinates. Lagrange's equations. Prerequisites: MatE. 102 and Math. 220.

312.   NONLINEAR OSCILLATIONS. 4 HOURS. Exact and approximate methods of studying vibrations of nonlinear systems. Analytical and graphical techniques. Forced oscillations, self-excited systems, stability criteria. Computer methods. Practical applications. Prerequisite: MatE. 208.

313.   APPLIED DYNAMICS. 4 HOURS. Analytical methods in the study of dynamic forces in machines. Application of the methods to linkages, cam-systems, balancing, and critical speeds. Prerequisites: MatE. 209 and 311.

316.   INTRODUCTION TO CONTINUUM MECHANICS. 4 HOURS. Same as Energy Engineering 316. Cartesian tensors, kinematics of fluids and solids, conservation equations, constitutive equations for simple materials. Examples. Prerequisites: EnrE. 211 or MatE. 204, and Math. 220.

321.   STRUCTURAL ANALYSIS II. 4 HOURS. Establishment of basic equations governing linear structural systems. Matrix inversion and relaxation solutions. Approximate analyses. Introduction to dynamics of structure. Prerequisite: MatE. 207.

322.   CONCRETE TECHNOLOGY. 4 HOURS. Relations between microstructure and macroproperties, mechanism of fracture, shrinkage and creep, new types of concrete, effects of environment and mixtures. Individual research project involving laboratory and analytic techniques. 3 hours, lecture; 2 hours, laboratory. Prerequisite: MatE. 203 or the equivalent.

324.   LIMIT ANALYSIS AND DESIGN OF STRUCTURES. 4 HOURS. Boundedness principles of perfect plasticity. Application to analysis and design of structures. Prerequisite: MatE. 207.

325.   CONCRETE DESIGN OF SHELL AND PLATE STRUCTURES. 4 HOURS. Derivation of membrane and bending theories for shells of revolution, folded plates, and shells of single and double curvature. Application to barrel roofs, domes, and storage tanks. Prerequisites: Math. 220 and MatE. 225 or 302.

326.   DESIGN IN PRESTRESSED AND PRECAST CONCRETE. 4 HOURS. Behavior and design of prestressed and precast concrete structures. Prestressing systems; problems of shrinkage, creep, and anchorage. Design of beams, slabs, containment vessels, and piles. Design of precast concrete building systems. Prerequisite: MatE. 225.

331.   ELECTRON THEORY OF METALS. 3 HOURS. Modern physical concepts of metals and alloys. Introduction to wave mechanics. Thermal, electrical, and magnetic properties of metals. Band theory of metals. Prerequisite: MatE. 252.

332.   ADVANCED DIFFRACTION ANALYSIS. 3 HOURS. Single crystal methods in X-ray diffraction, orientation determination, pole figures, structure

determination, precision lattice constant methods. Prerequisite: MatE. 239 or the equivalent.

333.   DESIGN USE OF MATERIALS. 4 HOURS. Extreme value statistics, mechanical effects of a notch. Fracture mechanics. Fatigue. Stress rupture. Residual stress effects. Relationships to designed performance. Prerequisite: MatE. 230.

334.   METALLURGY OF NUCLEAR MATERIALS. 3 HOURS. Basic principles of nuclear reactors, fission, moderation, poisoning, radioactivity. Selection of materials for fuels, cladding, moderators, coolants, and shields with regard to a reactor environment. Radiation effects, heat transfer, environmental problems, reactor safety, and neutron conservation. Prerequisites: Phys. 232 or the equivalent, MatE. 252.

335.   ELECTRON MICROSCOPY. 3 HOURS. The electron microscope and its application to the study of surface replicas and thin films of metals, alloys, and other materials. Sources of contrast. Selected area diffraction. Prerequisites: MatE. 239 and 252.

337.   PROCESS METALLURGY OF IRON AND STEELMAKING. 4 HOURS. Physicochemical principles applied to reduction, conversion, and refining of steel and ferrous alloys. Applications of thermodynamics to equilibrium problems, such as slag-metal equilibria, and applications of process engineering principles to the dynamic behavior of various component systems, such as sinter plants, blast furnaces, and basic oxygen furnaces. Prerequisite: MatE. 243.

338.   PARTICULATE SOLIDS PROCESSING. 4 HOURS. Characterization of particulate solids by size and shape. Size classification and reduction. Wet and dry fluid-solid and solid-solid separation processes. Transportation and agglomeration of particulate solids. Lecture and laboratory. Prerequisites: EnrE. 211, MatE. 200 and 230.

339.   ELECTRONIC MATERIALS PROCESSING. 4 HOURS. Materials processing methods germane to materials for electronics applications, including magnetic, dielectric, and strain-sensitive materials; semiconductor materials. Prerequisite: MatE. 230.

344.   PHYSICAL-CHEMICAL PRINCIPLES OF SOIL BEHAVIOR I. 4 HOURS. Clay mineralogy, soil formation and composition, sedimentation, mineral identification, colloidal phenomena in soils. Prerequisite: MatE. 260.

345.   PHYSICAL-CHEMICAL PRINCIPLES OF SOIL BEHAVIOR II. 4 HOURS. Swelling, ion association, soil-water analysis of mechanical behavior of soils in terms of physiochemical principles, and conduction phenomena. Prerequisite: MatE. 344.

346.   PHYSICAL-CHEMICAL PRINCIPLES OF SOIL BEHAVIOR III. 4 HOURS. Deformation mechanisms and strength, compaction, frost action, rate processes, such as secondary compression, creep, thixotropy. Prerequisite: MatE. 345.

360.   DEFORMATION PROCESSING. 4 HOURS. Principles of deformation processes. Basic methods of problem solving. Practices and process control. Relations between processing and finished properties. Prerequisites: MatE. 201 and 230.

361.   DEFORMATION PROCESSING LABORATORY. 2 HOURS. Measurement and analysis of forces in forging, rolling, drawing and deep drawing. Effects of material properties, process variables and friction conditions. Prerequisites: MatE. 202 and 360.

362.   POWDER METALLURGY. 3 HOURS. Physical attributes of fine powders. Mechanics of pressing. Theories of solid state sintering. Liquid phase sintering. Manufacturing aspects. Prerequisite: MatE. 230.

363.   ADVANCED PHASE DIAGRAMS. 4 HOURS. Ternary phase equilibria in metal systems. Vertical and horizontal sections, methods of construction and interpretation. Examination of quaternary and more complex systems. Application of thermodynamic principles to construction. Prerequisite: MatE. 250.

364.   POLYMER PROPERTIES AND TECHNOLOGY. 4 HOURS. Polymer structure and properties. Characterization of polymeric materials. Polymer processing and manufacturing technology. Prerequisite: MatE. 230.

367.   CERAMICS TECHNOLOGY. 4 HOURS. An introductory course in ceramics for engineers. Ceramics as materials of technological importance are examined from the science, engineering, and manufacturing viewpoints. Crystalline and noncrystalline (glass) materials are covered. Special emphasis on applications in industry. Prerequisite: MatE. 230.

368.   SOLIDIFICATION THEORY AND PRACTICE. 3 HOURS. Theory of solidification and its applications to problems in castings and refining of crystalline materials. Prerequisites: MatE. 244, 248.

370.   SOIL MECHANICS I. 4 HOURS. The nature of soils and soil deposits; stresses in soil masses; granular materials; stress-strain behavior and shear strength, earth pressures on retaining structures, bearing capacity and settlements of shallow foundations. Two laboratory exercises in stresses and settlements of shallow foundations. Prerequisite: MatE. 260.

371.   SOIL MECHANICS II. 4 HOURS. Concept of effective stress; seepage and pore pressures; stress-strain behavior and shear strength of drained cohesive materials; earth retaining structures; slope stability. One laboratory exercise in the principle of effective stress. Prerequisite: MatE. 370.

372.   SOIL MECHANICS III. 4 HOURS. Consolidation theory; stress-strain behavior and shear strength of undrained cohesive materials; soil-structure interaction; formulation and computer solution of field problems. Prerequisites: MatE. 371, Math. 195 or programming experience.

373.   LABORATORY DETERMINATION OF SHEAR STRENGTH OF SOILS. 2 HOURS. Approximately 4 hours per week of laboratory-lecture. Prerequisite: Credit or concurrent registration in MatE. 372.

381.   NOISE AND VIBRATION CONTROL. 4 HOURS. Nature of sound as it relates to the control of vibration and wave propagation. Design procedure based on hearing, acoustical environment, acoustical materials, and soil dynamics. Legal and medical problems. Prerequisite: MatE. 208 or the equivalent.

383.   DESIGN OF FILM BEARINGS. 4 HOURS. Application of mechanics to the design of film bearings. Journal bearings. Thrust bearings. Slider bearings. Cavitation cooling requirements. Materials and manufacturing considerations. Prerequisites: EnrE. 211, Math. 220.

384.   DESIGN IN MATERIAL PROCESSES. 3 HOURS. Design and optimization of chemical and mechanical metallurgical processing systems. Process modeling and analysis. Direct search linear and dynamic programming solutions of process problems. Economic analysis and investment strategy. Prerequisite: MatE. 243 or 244, or EnrE. 234.

391.   SEMINAR. 1 HOUR. Topics to be arranged. Prerequisite: Consent of the instructor.

393.   SPECIAL PROBLEMS. 2 TO 4 HOURS. Special problems or reading by special arrangement with the faculty. Prerequisite: Consent of the instructor.

396.   SENIOR DESIGN I. 4 HOURS. Same as Energy Engineering 396, Information Engineering 396, and Systems Engineering 396. Introduction to engineering economics, legal and social constraints on design, safety and reliability theory, and the use of simulation and optimization techniques in the engineering design process. Prerequisite: Senior standing in the College of Engineering.

397.   SENIOR DESIGN II. 4 HOURS. Same as Energy Engineering 397, Information Engineering 397, and Systems Engineering 397. Application of principles of engineering and engineering design methodology to the solution of a large-scale design problem. May be taken in any department, regardless of area of concentration. Prerequisite: MatE. 396.

Courses for Graduate Students

402.   APPLIED ELASTICITY II. 4 HOURS. Development of classical plate equation and boundary conditions; solution of problems in rectangular and polar coordinates; energy principles; plates with variable thickness; large deflection theory; effect of shear deformations. Prerequisite: MatE. 302.

403.   THEORY OF ELASTICITY II. 4 HOURS. Review of complex variable theory, application to torsion, bending, and plane problem. The general three-dimensional problem, stress functions, singularities. Introduction to elastokinetics. Prerequisite: MatE. 303.

404.   PLASTICITY I. 4 HOURS. Basic postulates of plasticity. Yield conditions and associated flow laws. Torsion of cylindrical and prismatic bars. Generalized

stresses and strain rates. Theorem of limit analysis. Application of limit analysis to plane problems, plates, and shells. Prerequisite: MatE. 316.

406.   THEORY OF SHELLS. 4 HOURS. Differential geometry, geometry of deformation, equations of equilibrium, energy theories, membrane theory, general bending theory. Application to shells of different geometry. Prerequisites: MatE. 302 and Math. 322.

408.   THEORY OF VISCOELASTICITY. 4 HOURS. Establishment of the field equations of viscoelastic materials and mathematical techniques of solving these equations. Prerequisites: MatE. 303 and Math. 322.

409.   ANALYSIS AND SYNTHESIS OF MECHANISMS III. 4 HOURS. Advanced analysis and synthesis of motion, emphasis on spatial mechanisms. Screw chains, dual numbers, quaternions. Matrix methods, stretch-rotation tensors, canonical systems and instantaneous invariants. Applications. Prerequisite: MatE. 309.

411.   VIBRATIONS OF STRUCTURAL ELEMENTS. 4 HOURS. Analytic and numerical treatment of vibrations in elastic strings, beams, plates, and other elements. Prerequisite: MatE. 308.

412.   WAVE PROPAGATION IN SOLIDS I. 4 HOURS. Stress wave propagation in solids; emphasis on waves involving one space variable in linear and nonlinear materials. Analytical and experimental techniques. Laboratory demonstrations. Prerequisites: MatE. 302 and Math. 322.

413.   WAVE PROPAGATION IN SOLIDS II. 4 HOURS. Wave propagation in solids which involve more than one space variable. Waves in a half-space due to a pulse on the surface or inside the half-space. Waves in cylindrical rods, beams, and plates. Scattering problems. Wave front analysis by geometrical optics. Prerequisite: MatE. 412.

414.   ANALYTICAL ENGINEERING DYNAMICS I. 4 HOURS. Lagrangian formulation of mechanics. Generalized kinematics. Partial rates of change of position and orientation. Lagrange's form of D'Alembert's principle. Lagrangian statics. Lagrange's equations of the first and second kind. Virtual work. Activity-energy. Prerequisite: Math. 321.

415.   ANALYTICAL ENGINEERING DYNAMICS II. 4 HOURS. Continuation of advanced mechanics. Integration of Lagrange's dynamical equations. Hamilton's canonical equations. The energy integral. Momentum integrals and cyclic coordinates. Canonical variables and transformations. The Hamilton-Jacobi equation. Prerequisite: MatE. 414.

416.   ANALYTICAL ENGINEERING DYNAMICS III. 4 HOURS. Variational approach to dynamics: Hamilton's principle, optimization techniques. Legendre transformations and Hamilton's equations. Introduction to relativistic dynamics. The Lorentz transformation. Prerequisite: MatE. 415.

419.   NONLINEAR CONTINUUM MECHANICS I. 4 HOURS. Same as Energy Engineering 419. Kinematics and fundamental laws of mechanics. General

constitutive equations; reduced constitutive equations. Homogenous motions of simple bodies. Isotropic group, simple fluids, simple solids, simple subfluids. Examples. Prerequisite: MatE. 316.

420. **NONLINEAR CONTINUUM MECHANICS II. 4 HOURS.** Same as Energy Engineering 420. Special classes of materials. Simple fluids, viscometric flows, the Weissenberg effect. Isotropic elastic materials, exact solutions. Wave propagation. Thermodynamics. Nonlinear viscoelastic materials, polar materials, and other materials. Prerequisite: MatE. 419.

421. **STRUCTURAL ANALYSIS III. 4 HOURS.** Applications of matrix, numerical, and computer techniques to the analysis of complex structural systems. Prerequisite: MatE. 321 or the equivalent.

422. **ADVANCED DESIGN OF CONCRETE STRUCTURES. 4 HOURS.** Behavior of reinforced and prestressed concrete members subjected to flexure, shear, torsion, and compression; problems of bond failure, creep, and crack width control; limit design of continuous beams and yield line analysis of slabs; considerations of safety and probability in design codes. Prerequisite: MatE. 326 or the equivalent.

423. **ELASTIC INSTABILITY I. 4 HOURS.** Principles of elastic instability and their analytical, numerical, and experimental treatment. Buckling of columns, frames, rings. Lateral and torsional instability. Prerequisite: MatE. 302. A knowledge of partial differential equations is required.

424. **ELASTIC INSTABILITY II. 4 HOURS.** General discussion: small displacements superimposed on finite deformations; application to plates and shells; post-buckling analysis; dynamics instability. Prerequisite: MatE. 423. A knowledge of partial differential equations is required.

425. **STRUCTURAL DYNAMICS. 4 HOURS.** Development of discrete element and numerical techniques for structural dynamics problems; application to seismic and blast analysis. Prerequisites: MatE. 308, 321.

432. **DISLOCATION THEORY. 4 HOURS.** Nature of dislocation in crystals. Static and dynamic behavior. Interaction with solute atoms, precipitates, and other dislocations. Effect on mechanical properties. Dislocation interactions, reductions, and dislocation arrays. Prerequisite: MatE. 316.

433. **ADVANCED MECHANICAL METALLURGY. 4 HOURS.** Mechanical flows of metals and alloys from the standpoint of continuum mechanics. Application to basic metal-forming operations. Prerequisite: MatE. 360.

434. **ADVANCED EXPERIMENTAL METHODS IN MATERIALS I. 4 HOURS.** First of two courses covering the theoretical and operational aspects of advanced materials research methods at an advanced level. Design of complex experimental devices. Applications and limitations. Treatment of data. Principal topics include vacuum technology and temperature measurement and control. Prerequisite: MatE. 333.

435. ADVANCED EXPERIMENTAL METHODS IN MATERIALS II. 4 HOURS. Second of two courses covering the theoretical and operational aspects of materials research methods at an advanced level. Design of complex experimental devices. Applications and limitations, treatment of data. Principal topics include mechanical and physical property measurements under special environments. Prerequisite: MatE. 434.

441. MECHANICS OF MULTIPHASE SYSTEMS. 4 HOURS. Three-dimensional theory of multiphase media including effects of applied forces, thermo-osmosis, electro-osmosis, and chemical potentials. Three-dimensional theory of consolidation; derivation, solution by analytical and numerical means. Analysis of three-dimensional consolidation effects. Prerequisites: MatE. 316 and 341.

442. STRENGTH AND DEFORMATION THEORIES OF SOIL. 4 HOURS. Theories of plasticity as applied to soil mechanics. Problems of limiting equilibrium. Application of plasticity theories to problems of bearing capacity, earth pressure, and slope stability. Mechanics of granular systems. Prerequisites: MatE. 316 and 341. A knowledge of partial differential equations is required.

447. ADVANCED SOIL ENGINEERING I. 4 HOURS. Analysis of displacements of structures due to earth deformation. Site exploration; analysis of foundation types; shallow and deep foundations; settlements; bearing capacity. Retaining structures. Prerequisite: MatE. 261.

461. ADVANCED DEFORMATION PROCESSING I. 4 HOURS. Fundamental aspects of yielding and ductile failure in important deformation modes. Deformation of crystal aggregates and development of textures. Metallurgical changes during deformation. Effect of plastic flow on basic friction processes. Prerequisite: MatE. 360.

462. ADVANCED DEFORMATION PROCESSING II. 4 HOURS. Interactions between workpiece and equipment. Dynamic response of system. Design of process around material. Experimental techniques. Prerequisite: MatE. 461.

463. FUNDAMENTALS OF FRICTION, LUBRICATION, AND WEAR. 4 HOURS. Measurement and theories of friction. Adhesion between similar and dissimilar material pairs. Mechanisms of wear. Boundary, thin film, hydrodynamic and elastohydrodynamic lubrication. Prerequisite: MatE. 230.

465. ADVANCED METALLURGICAL THERMODYNAMICS. 4 HOURS. Treatment of multicomponent system thermodynamics with emphasis on metallurgical process applications. Development of relation between structure of metallic solutions, molten slats, and quasi-chemical models. Introduction to the relations between defects in nonmetallic crystals and the gas-phase composition. Prerequisite: EnrE. 305.

466. EMBRITTLEMENT PHENOMENA I. 4 HOURS. Phenomenology of mechanics of cracking or rupture originating from combinations of temperature, microstructure, environment, and stress. Prerequisite: MatE. 333.

467. EMBRITTLEMENT PHENOMENA II. 3 HOURS. Continues Materials Engineering 466. Prerequisite: MatE. 466.

493. SPECIAL PROBLEMS. 1 TO 4 HOURS. Special topics, seminars, or other special activities.

494. SPECIAL TOPICS IN PROCESS METALLURGY. 0 TO 4 HOURS. May be repeated for a maximum of 12 hours. Selected topics of special interest in the design and analysis of mineral and metal production processes, including transport phenomena, physical chemistry, and design, control, and optimization problems. Prerequisite: MatE. 248 or the equivalent.

495. SPECIAL TOPICS IN PHYSICAL METALLURGY. 4 HOURS. May be repeated for a maximum of 12 hours. Selected topics of current interest drawn from such areas as structures, kinetics, diffusion, and quantitative metallography. Prerequisite: Consent of the instructor.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Individual research: reading, design, analytical studies, or laboratory assignments. Culminates in report, master's thesis, or doctoral thesis. Examination on report or thesis is required.

MATHEMATICS

Professors. Joseph Landin, Head of the Department; A.O.L. Atkin, Norman Blackburn, Djairo G. DeFigueiredo, Philip Dwinger, Irwin K. Feinstein, Paul Fong, Evelyn Frank, Victor K.A.M. Gugenheim, Christoph Hering, Noboru Ito, Shmuel Kantorovitz, Marvin I. Knopp, Louis Pennisi, Reuben I. Sandler, W.F. Stinespring, Victor Twersky

Associate Professors: Eugene M. Barston, Aldridge K. Bousfield, David Foulser, Brayton I. Gray, Richard Handelsman, Morton E. Harris, Louise Hay, Melvin L. Heard, Jr., William A. Howard, James J. Kelleher, Richard G. Larson, Sue-Chin Lin, James W. Moeller, T. Parthasarathy, T.E.S. Raghavan, G.V. Ramanathan, Neil W. Rickert, Stanley L. Sclove, Robert I. Soare, Martin C. Tangora

Assistant Professors: Bernard M. Berlowitz, Joel D. Berman, Verena H. Dyson, Gerald L. Gordon, Robert N. Grannick, Floyd B. Hanson, Steven L. Jordan, Louis H. Kauffman, Jeffrey S. Leon, Jeff E. Lewis, Mu-chou Liu, John M. Masley, Kenneth W. Newman, John A. Sanders, Glenn P. Weller

The department offers graduate work leading to the Master of Arts, the Master of Science, the Master of Science in the Teaching of Mathematics, the Doctor of Arts, and the Doctor of Philosophy.

The student will choose a major subject from the following: algebra, analysis, applied mathematics, geometry, logic, number theory, probability and statistics, or topology. He must also choose two internal minors from the preceding list or one internal minor and one outside minor or a full outside minor. The choice of an outside minor must have the approval of the Department of Mathematics. The requirements for such a minor should be checked with the department concerned. The student will present at least 60 quarter hours in 400-level mathematics courses unless he has chosen a full outside minor that requires 48 hours. At least three 400-level courses are required for each internal minor. Courses must have the approval of the department.

Admission Requirements

Applicants must have a grade-point average of 3.75. The average is computed from the last 90 quarter hours of work completed, including undergradute and graduate courses. Students with averages below 3.75 but above 3.50 are considered on an individual basis. An applicant must also have a 4.00 average in all mathematics courses beyond calculus.

Applicants must also present 30 quarter hours of undergraduate work in mathematics in addition to the usual beginning courses in algebra, trigonometry, analytic geometry, and calculus. For the master's degree in mathematics these 30 hours must include one year of work in analysis (equivalent to Mathematics 310, 311, 312) and one year of work in an introduction to higher algebra (equivalent to Mathematics 340, 341, 342). The remaining hours should be in mathematics courses at the 300 level (or their equivalents.) Degree requirements are stated below.

Applicants are required to take the Graduate Record Examination (Verbal, Quantitative, and Advanced) and to submit three letters of recommendation from persons familiar with their academic work. If a candidate is admitted with deficiencies in courses normally required for admission, he must remove such deficiencies during the first three quarters of his attendance. No graduate credit is given for such courses. An applicant may petition to receive credit for graduate work done at a recognized institution.

Degree Requirements

Master of Arts and Master of Science in Mathematics

Forty-eight quarter hours are required for the degree, of which at least 36 must be in mathematics. At least 20 of the 36 hours must be in approved 400-level courses. The candidate must pass a written examination, details of which may be obtained from the department coordinator of graduate studies. A thesis is not required.

Master of Science in the Teaching of Mathematics

The purpose of this program is to strengthen the preparation of present and future secondary school teachers of mathematics and, in particular, to provide courses leading to certification in the State of Illinois for those candidates who are not already certified.

The course requirements provide for the admission of students of varying undergraduate backgrounds and include a number of courses required in the undergraduate curriculum in teacher education in mathematics. Therefore, the requirements may be met either by work completed in the student's undergraduate program or by work done in his graduate program, but the graduate program must include 48 quarter hours of graduate credit.

Applicants must meet the required grade-point average stated in the general admission requirements and must have completed 30 quarter hours of undergraduate mathematics in courses beyond calculus.

A candidate must earn 48 quarter hours of graduate credit, of which 24 hours must be in mathematics, 12 hours in psychology or education, and 12 hours in electives. At the conclusion of this program the student must have completed, either as part of the required 48 quarter hours or as part of his undergraduate program, the following:

1. Mathematics 310 and at least 4 quarter hours of analysis beyond Mathematics 310.
2. Mathematics 340, 341, and at least 4 quarter hours of algebra beyond Mathematics 341.
3. Mathematics 303, 304, 305 and at least 4 quarter hours of geometry beyond Mathematics 305.
4. At least 4 quarter hours in a course concerned with the problems of teaching secondary school mathematics.
5. At least 12 quarter hours of graduate credit in mathematics, to be chosen, with the approval of his adviser, from logic, finite differences, number theory, history of mathematics, topology, computer science, probability and statistics, or other fields.

In addition, he must be eligible for a certificate to teach mathematics at the secondary level in the State of Illinois. This requirement may be waived for candidates with teaching experience.

The psychology or education courses and the electives must be chosen with the approval of the adviser. In general, the electives will be chosen from courses in mathematics, psychology, or education. In exceptional cases courses in other fields may be used as electives. Courses at the 400 level are not required for the degree.

Candidates whose undergraduate work is comparable to that required at Chicago Circle for a Bachelor of Science in the Teaching of Mathematics can fulfill the requirements in one year. A candidate who has not completed comparable work in analysis, algebra, and geometry cannot expect to qualify for the degree in one year and will need more than 48 hours of course work

to fulfill the requirements.

For further details concerning certification and any other requirements, candidates should consult the program adviser.

Doctor of Arts

The Doctor of Arts in Mathematics is designed to educate undergraduate instructors for employment in universities and four-year and community or junior colleges. The course of study for students who have the baccalaureate in mathematics, the master's in mathematics, or the master's in the teaching of mathematics consists of concentrated study in mathematics and study and research in the methodology and techniques for successful teaching of mathematics. The Doctor of Arts program is designed to develop the student's breadth of knowledge and skill in the content and teaching of undergraduate mathematics. The program requires 144 quarter hours of instruction:

A. 60 quarter hours of mathematics, including Mathematics 332, 333, 355, 401, 402, 430, and 431. In addition, the student must obtain at least 4 quarter hours of credit in each of any four of the following areas: computer science, differential equations, geometry, logic, and probability and statistics. The remaining 16 quarter hours will be selected by the student with the approval of his adviser. At least 32 of the 60 quarter hours must be taken in mathematics courses at the 400 level.

B. 12 quarter hours of graduate courses in a related science, such as physics, chemistry, biology, geology, physical geography, or another science with the approval of the department.

C. 24 quarter hours of graduate courses in education and mathematics education directed toward the improvement of university and junior college teaching.

D. A teaching practicum, directed and supervised by members of the department, for which 8 quarter hours of credit will be awarded. Doctor of Arts candidates who have had teaching experience may request a proficiency examination to satisfy the teaching practicum requirement. A committee of members of the department will prepare and offer the examination.

E. 8 quarter hours of electives restricted to mathematics and/or science. Courses in economics and statistical methods in psychology and education may, under certain conditions, be selected in this category.

F. 32 quarter hours will be devoted to the writing of a thesis, either an expository or historical treatment of a mathematics topic or a research report on mathematics education.

Doctor of Philosophy

Each candidate for the doctorate must pass the master's examination and must be recommended by the department for further study. A candidate who has not passed this examination within one year of his admission will be dropped from the program. In exceptional circumstances the department may extend this time limit.

The student will choose a major subject from the following: algebra, analysis, applied mathematics, geometry, logic, number theory, probability and statistics, or topology. He must also choose two internal minors from the preceding list or one internal minor and one outside minor or a full outside minor. The choice of an outside minor must have the approval of the Department of Mathematics; the requirements should be checked with the department concerned. The student will present at least 60 quarter hours in 400-level mathematics courses unless he has chosen a full outside minor that requires 48 hours. At least three 400-level courses are required for each internal minor, and they must have the approval of the department. The student is required to have 144 hours of graduate credit, of which 48 hours will usually be thesis credit.

Shortly before the completion of 96 hours of graduate course work the student should select an adviser to direct a thesis in his major area of interest. As soon as possible thereafter, the student must take a preliminary examination, the purpose of which is to determine if he is prepared to undertake a doctoral research program. The exact point in the student's career at which the preliminary examination must be taken is not rigidly fixed, but the department will normally drop a student who has not passed the preliminary examination within one year of completion of the 96 hours of course work. In exceptional circumstances the department may extend this time limit. Further details regarding the examination may be obtained from the graduate coordinator of the department.

The student must demonstrate reading proficiency in any two of French, German, or Russian.

Since the purpose of the doctoral program is to provide training in mathematical research and scholarship, the crucial effort is the production of a thesis; therefore, under the guidance of the department, the student will write a thesis that is a significant piece of mathematical research acceptable to the department.

Courses for Graduate and Advanced Undergraduate Students

300. TEACHERS COURSE I. 4 HOURS. Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Important mathematical concepts and the problems involved in the teaching thereof; treatment of numeration systems, set relations, functions, whole numbers, logic, and proof; examination of some of the major new curricula. Prerequisite: Math. 133.

301. TEACHERS COURSE II. 4 HOURS. Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Continues Mathematics 300. Topics, discussed from an advanced viewpoint, include mathematical induction, the completeness axiom, composition of functions, sequences, a vector approach to geometry, axioms of the Hilbert type. Prerequisite: Math. 300.

302. TEACHERS COURSE III. 4 HOURS. Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Continues Mathematics 301. Topics, discussed from an advanced viewpoint, include arithmetic and geometric progressions, continued sums and products, difference sequences, pigeon-hole principle, limits, continuity, exponential functions, logarithmic functions, circular functions, combinations and permutations. Prerequisite: Math. 301.

303. ADVANCED EUCLIDEAN GEOMETRY I. 4 HOURS. Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Geometry from Euclid to the present, equivalents of Euclid's fifth postulate, noneuclidean geometries, finite and projective geometries, invariants of configurations under transformation. Prerequisite: Math. 133.

304. ADVANCED EUCLIDEAN GEOMETRY II. 4 HOURS. Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. The parallel postulate, similarity, area, perpendicularity, circles and spheres, constructions with ruler and compass. Prerequisite: Math. 303.

305. ADVANCED EUCLIDEAN GEOMETRY III. 4 HOURS. Graduate credit for this course may be applied only toward the course requirements for the Master of Science in the Teaching of Mathematics. Ruler and compass constructions, proportionality, length and area, solid mensuration, hyperbolic geometry. Prerequisite: Math. 304.

307. THEORY OF SETS AND THE REAL NUMBER SYSTEM. 5 HOURS. The elementary set theory and the development of the integers, the rational numbers, and the real numbers. Prerequisite: Math. 133.

309. TOPICS IN THE TEACHING OF MATHEMATICS. 4 HOURS. May be repeated for credit. No more than 8 hours may be used toward the Master of Science in the Teaching of Mathematics. Seminars, conferences, or sections on special topics and advanced problems for students majoring in mathematics education and for in-service teachers who wish to study new-curriculum development and special problems in teaching mathematics. Prerequisite: Math. 302.

310. ADVANCED CALCULUS I. 4 HOURS. Differential and integral calculus of vector fields, vector functions, partial differentiation, transformations, improper integrals, double and triple integrals, and applications. Prerequisite: Math. 133.

311. ADVANCED CALCULUS II. 4 HOURS. Line and surface integrals, Green's theorem, Stokes' theorem, sequence, infinite series, uniform convergence. Prerequisite: Math. 310.

312. ADVANCED CALCULUS III. 4 HOURS. A set of advanced topics selected for applications in the physical sciences and in engineering. Prerequisite: Math. 311.

313. ANALYSIS I. 4 HOURS. The real numbers, countable and uncountable sets, the topology of the reals, compactness, convergent and divergent sequences, Cauchy sequences, infinite series, convergence tests, rearrangements, the topology of n-space, continuous functions and their properties. Prerequisites: Math. 133.

314. ANALYSIS II. 4 HOURS. The derivative, mean value theorems, Taylor's theorem with remainder, the Riemann integral, integrability of continuous functions, the fundamental theorem of calculus, convergence of sequences and series of functions, uniform convergence, conditions for piece wise differentiability and integrability, power series. Prerequisite: Math. 313.

315. ANALYSIS III. 4 HOURS. Differentiation in n-space, partial derivatives, the derivative as a linear approximation, inverse and implicit function theorems, integration in R^n, change of variables in integration, differential forms and integration of differential forms, Stokes' theorem. Prerequisite: Math. 314.

321. ELEMENTARY DIFFERENTIAL EQUATIONS II. 4 HOURS. Systems of linear first order equations. Boundary value problems for second order linear equations, introduction to partial differential equations. Nonlinear problems described by one or two differential equations of first order. Prerequisite: Math. 220.

322. ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS I. 4 HOURS. Second order linear partial differential equations and their initial value and boundary value problems. Separations of variables and Green's formula considerations. Eigenfunction expansions for homogeneous and inhomogeneous heat equation in finite domains. Sturm-Liouville problem. Fourier series. Prerequisites: Math. 310 or 313 and Math. 321.

323. ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS II. 4 HOURS. The potential equation and the wave equation in finite domains. Semi-infinite domains. Fourier integrals. Cylindrical and spherical harmonics. Fourier-Bessel and Legendre-Bessel expansions. Prerequisite: Math. 322.

324. SPECIAL FUNCTIONS IN PURE AND APPLIED MATHEMATICS I. 4 HOURS. Special functions, including gamma, beta, cylinder, hypergeometric, and Bessel functions as they occur in pure and applied mathematics and engineering. Prerequisite: Credit or registration in Math. 321.

325. SPECIAL FUNCTIONS IN PURE AND APPLIED MATHEMATICS II. 4 HOURS. Special functions and polynomials, including orthogonal, Legendre, Hermite, Laguerre, and Jacobi polynomials as they occur in pure and applied mathematics and engineering. Prerequisite: Math. 324.

326. SPECIAL FUNCTIONS IN PURE AND APPLIED MATHEMATICS III. 4 HOURS. Continued study of special functions, including hypergeometric and Bessel functions, generating functions, and orthogonal, Legendre, Hermite, Laguerre, and Jacobi polynomials as they occur in pure and applied mathematics. Prerequisite: Math. 325.

330. COMPLEX ANALYSIS FOR APPLICATIONS I. 4 HOURS. Credit is not given for both Mathematics 330 and 332. Complex numbers and their geometrical representation, analytic functions, elementary functions, complex integration, Taylor and Laurent series, the calculus of residues, introduction to conformal mapping. Prerequisite: Math. 310 or 313.

331. COMPLEX ANALYSIS FOR APPLICATIONS II. 4 HOURS. Branch-point integration, series and product expansions, complex integral representations of special functions (gamma, hypergeometric, Legendre, Bessel), asymptotic methods, introduction to transforms. Prerequisites: Math. 321 and 330.

332. COMPLEX VARIABLES I. 4 HOURS. Credit is not given for both Mathematics 332 and 330. Power series in one variable, holomorphic functions, Cauchy's integral theorem, Taylor and Laurent expansions. Prerequisite: Math. 312 or 315 or the equivalent.

333. COMPLEX VARIABLES II. 4 HOURS. Analytic functions of several complex variables, harmonic functions, convergence of sequences of holomorphic functions, infinite products, normal families, holomorphic transformations, holomorphic systems of differential equations. Prerequisite: Math. 332.

340. MODERN HIGHER ALGEBRA I. 4 HOURS. Sets and real numbers, groups, rings. Prerequisite: Math. 133.

341. MODERN HIGHER ALGEBRA II. 4 HOURS. Euclidean and polynomial rings, vector spaces, linear transformations, and matrices. Prerequisite: Math. 340.

342. MODERN HIGHER ALGEBRA III. 4 HOURS. Dual spaces, inner products spaces, modules, canonical forms of matrices, quadratic forms. Prerequisite: Math. 341.

343. FORMAL LOGIC I. 4 HOURS. Same as Philosophy 343. Propositional logic, logic of quantifiers, and identity and completeness. Prerequisite: Consent of the instructor; none for mathematics majors.

344. FORMAL LOGIC II. 4 HOURS. Same as Philosophy 344. Continues Mathematics 343. Mathematical analysis of decidability and computability. Arithmetization of syntax. Incompleteness and undefinability theorems. Introduction to axiomatic set theory. Prerequisite: Math. 343.

348. LINEAR TRANSFORMATIONS AND MATRICES. 5 HOURS. Matrix algebra, determinants, inverses of matrices, rank and equivalence. linear independence, vector spaces and linear transformation, unitary and orthogonal transformations, characteristic equation of a matrix. Prerequisite: Math. 133.

350. INTRODUCTION TO HIGHER GEOMETRY I. 4 HOURS. Projective properties in the euclidean plane, extending the euclidean plane, the projective plane, axioms for the projective plane, conics, introduction of coordinates. Prerequisite: Math. 342.

351. **INTRODUCTION TO HIGHER GEOMETRY II. 4 HOURS.** Topics in geometry, projective planes, higher dimensional projective geometries, model as subspaces of a vector space, coordinatization. Prerequisite: Math. 350.

353. **INTRODUCTION TO DIFFERENTIAL GEOMETRY. 4 HOURS.** Curves, surfaces, manifolds imbedded in euclidean space, Riemannian geometry, first and second fundamental forms of imbedded surfaces. Prerequisite: Math. 312 or 315.

355. **INTRODUCTION TO TOPOLOGY I. 4 HOURS.** Set theory, topological spaces, metric spaces, continuous maps, connectedness, compactness, separation axioms, completely separable spaces, mappings into Hilbert spaces. Prerequisite: Math. 310 or 313.

356. **INTRODUCTION TO TOPOLOGY II. 4 HOURS.** Locally connected spaces, arcs and arcwise connectivity, Cantor sets, Hahn-Mazurkiewicz theorem, elements of homotopy theory. Prerequisites: Math. 340 and 355.

357. **INTRODUCTION TO TOPOLOGY III. 4 HOURS.** Vector spaces, polytopes, homology theory, Euler-Poincare formula, simplicial mappings, Brouwer degree and Brouwer fixed-point theorem. Prerequisite: Math. 356.

358. **STATISTICAL METHODS. 4 HOURS.** Statistical concepts, techniques, and methods. Topics include probability theory and models, statistical estimation, confidence limits, and hypothesis testing. Prerequisite: Math. 133.

360. **ELEMENTARY THEORY OF NUMBERS I. 4 HOURS.** The basic concepts of the theory of numbers: divisibility, prime numbers congruences, quadratic reciprocity law. Prerequisite: Math. 133 or approval of the department.

361. **THEORY OF NUMBERS II. 4 HOURS.** Functions of number theory, recurrence functions, diophantine equations, quadratic forms, Farey sequences and rational approximations. Prerequisite: Math. 360.

362. **THEORY OF NUMBERS III. 4 HOURS.** Continued fractions, distribution of primes, algebraic numbers, polynomials, partitions, density of sequences of integers. Prerequisite: Math. 361.

366. **INTRODUCTION TO THE MATHEMATICAL METHODS OF THEORETICAL PHYSICS I. 4 HOURS.** Same as Physics 366. The traditional mathematical methods of theoretical physics from an intuitive point of view. Applications to problem solving in electrostatics and classical and quantum mechanics. Matrices and linear transformations, Fourier analysis, the partial differential equations of physics, and Sturm-Liouville theory. Introduction to special functions frequently encountered in physics. Prerequisites: Math. 310, 321; Phys. 303, 322, 342.

367. **INTRODUCTION TO THE MATHEMATICAL METHODS OF THEORETICAL PHYSICS II. 4 HOURS.** Same as Physics 367. The traditional mathematical methods of theoretical physics from an intuitive point of view. Applications to problem solving in electrostatics, electrodynamics, and classical and quantum mechanics. The special functions frequently encountered in physics and their use

in the solution of boundary value problems, power series solutions, Green's functions, contour integral representations, and additional uses. Prerequisite: Math. 366.

370. INTRODUCTION TO PROBABILITY AND STATISTICS. 4 HOURS. Probability models, univariate and multivariate distributions, random variables. Prerequisite: Math. 133.

371. STATISTICS I. 4 HOURS. Statistical problems and procedures, estimation, testing hypotheses, distribution theory. Prerequisite: Math. 370.

372. STATISTICS II. 4 HOURS. One-sample problems, comparison, linear models, and analysis of variance. Prerequisite: Math. 371.

375. PROBABILITY. 4 HOURS. Law of large numbers, central limit theorem, recurrent events, random walks, Markov chains. Prerequisite: Math. 370.

377. FINITE DIFFERENCES I. 4 HOURS. Difference formulas, finite integration, summation of series, Bernoulli and Euler polynomials, interpolation. Prerequisite: Math. 112 or 133.

378. FINITE DIFFERENCES II. 4 HOURS. Approximate integration, beta and gamma functions, difference equations. Prerequisite: Math. 377.

381. VECTOR AND TENSOR ANALYSIS I. 4 HOURS. Algebra of vectors, vector differential calculus, differential geometry, Stokes' theorem, divergence theorem, applications to electricity, mechanics, hydrodynamics, and elasticity. Prerequisite: Math. 311 or 314.

382. VECTOR AND TENSOR ANALYSIS II. 4 HOURS. Transformation properties, covariant and contravariant tensors, differential geometry of curves and surfaces, exterior differential calculus with emphasis on aspects of interest in science and engineering. Prerequisite: Math. 381.

383. INTRODUCTION TO GAME THEORY. 4 HOURS. Matrix games, saddle point, mixed strategies, zero-sum-two-person games, minimax theorem, examples from parlor games, poker, war games; computing value and optimal strategies using simplex method. Prerequisite: Math. 370.

385. LAPLACE TRANSFORMS. 3 HOURS. The Laplace transform and its inverse; properties of the transform; linear differential equations (ordinary and partial); linear difference equations, gamma, error and Bessel functions; asymptotic series; nonelementary integrals; integral equations, Hankel transforms. Prerequisite: Math. 330.

387. NUMERICAL ANALYSIS I. 4 HOURS. Mathematics 387 and 388 together provide a comprehensive introduction to linear numerical analysis. Computational methods and error analysis for matrix inversion, eigenvalues and eigenvectors, and linear approximations. Prerequisites: Math. 133, Math. 194 or 195.

388. NUMERICAL ANALYSIS II. 4 HOURS. Continues Mathematics 387. Prerequisite: Math. 387.

389. NUMERICAL ANALYSIS III. 4 HOURS. Numerical integration and differentiation. Quadrature in n dimensions. Numerical integration of ordinary differential equations. Prerequisite: Math. 388.

391. BOOLEAN ALGEBRA AND SWITCHING THEORY. 4 HOURS. Sets, relations, functions, equivalence relations, abstract Boolean algebra. Applications of Boolean algebra. Minimization of Boolean functions. Representation of finite Boolean algebras. Prerequisite: Math. 310 or 313 or 340.

392. INTRODUCTION TO AUTOMATA THEORY. 4 HOURS. Boolean rings and lattices as Boolean algebras. Synchronous sequential circuits. Mealy and Moore models of automata. Regular sets. Prerequisite: Math. 391.

393. AUTOMATA AND LANGUAGES. 4 HOURS. Types of automata and their events. The semigroup of an automaton. Basic decomposition theory. Introduction to formal languages. Grammars of types 0, 1, 2, 3. Properties of context-free languages. Prerequisite: Math. 392.

394. SIMULATION LANGUAGES. 4 HOURS. Digital simulation of complex systems; general purpose and special simulation languages and their useful properties, their design and implementation; a comparison and evaluation of special languages, such as GPSS II, SIMPSCRIPT, GASP, SIMPAC, DYNAMO, and SIMULATE: application of at least one of them in a term project. Prerequisites: Math. 280 and 281 or the equivalents.

395. LIST-PROCESSING LANGUAGES. 4 HOURS. List- and string processing languages, such as IPLV, SLIP, COMIT, SNOBOL, and LISP, from the user's point of view. Applications to nonnumeric problems, such as symbolic formula manipulation, information retrieval, and pattern recognition. Prerequisites: Math. 280 and 281 or the equivalents.

396. DESIGN OF COMPILERS. 4 HOURS. Design and implementation of algebraic compilers for a modern digital computer. Prerequisite: Math. 281.

397. COMPUTER OPERATING SYSTEMS. 4 HOURS. Problems of planning and implementing an operating system for a modern digital computer so as to utilize its power to the fullest possible extent. Prerequisite: Math. 281.

398. SPECIAL TOPICS IN MATHEMATICS. 1 TO 4 HOURS. May be repeated for credit. Course content will be announced prior to each quarter in which it is given. Prerequisite: Consent of the instructor.

399. HONORS IN MATHEMATICS. 4 HOURS. May be repeated for credit. Seminars on special topics and advanced problems to permit students majoring in mathematics to do independent study under the guidance of senior members of the staff. Prerequisites: Math. 312 and 342.

Courses for Graduate Students

401. SECOND COURSE IN ABSTRACT ALGEBRA I. 4 HOURS. Isomorphism theorems, permutation groups, finite groups, Sylow's theorems, structure of finitely generated Abelian groups, composition series, solvable groups. Prerequisite: Math. 342 or the equivalent.

402. SECOND COURSE IN ABSTRACT ALGEBRA II. 4 HOURS. Field extensions, finite fields, Galois theory, Wedderburn's theorem. Prerequisite: Math. 401.

403. SECOND COURSE IN ABSTRACT ALGEBRA III. 4 HOURS. Rings and algebras, structure of algebras, multilinear algebra, tensor products. Prerequisite: Math. 402.

404. RINGS AND MODULES. 4 HOURS. The category of R-modules, projective and injective modules, the Morita theorems, elementary homological algebra, separable algebras, homological dimension. Prerequisite: Math. 403.

405. FINITE GROUPS. 4 HOURS. Transfer theorems, p-nilpotent groups, E_π, C_π, D_π, properties, solvable groups, Schur-Zassenhaus theorem, additional topics selected by the instructor. Prerequisite: Math. 403.

406. FREE GROUPS AND UNIVERSAL PROPERTIES. 4 HOURS. Universal algebras, words and varieties, free algebras, free groups, sub-groups of free groups, free products, free associative algebras, Birkhoff-Witt theorem, free Lie algebras. Prerequisite: Math. 403.

407. REPRESENTATION THEORY. 4 HOURS. Representation theory of finite-dimensional algebras, structure of the regular representation, characters, applications to finite groups, theorems of Frobenius and Burnside, character ring, exceptional characters. Prerequisite: Math. 403.

408. HOMOLOGICAL ALGEBRA I. 4 HOURS. Abstract categories and functors, adjoints, additive and Abelian categories, functor categories. Prerequisite: Math. 403.

409. HOMOLOGICAL ALGEBRA II. 4 HOURS. Complexes, homology, projectives, and injectives, connected sequences of functors, satellites, derived functors, ext, tor, the full embedding theorem. Prerequisite: Math. 408.

410. NONASSOCIATIVE ALGEBRAS I. 4 HOURS. Introduction to nonassociative algebras, alternative algebras, power associative algebras, Jordan algebras. Prerequisite: Math. 403.

411. NONASSOCIATIVE ALGEBRAS II. 4 HOURS. Jordan algebras continued, Lie algebras, general classification theorems. Prerequisite: Math. 410.

415. LATTICE THEORY I. 4 HOURS. Introduction to the theory of lattices and partially ordered sets. Modular and distributive lattices, prime ideal theorem, Boolean algebras. Prerequisites: Math. 342, 356.

416. LATTICE THEORY II. 4 HOURS. Continues Math. 415. Representation theory of distributive lattices and its applications, Boolean algebras in particular. Prerequisite: Math. 415.

417. LATTICE THEORY III. 4 HOURS. Special topics. Pseudocomplemented, distributive lattices, Post algebras, Heyting algebras, Stone algebras, Lukasiewics algebras, de Morgan algebras, alpha complete lattices and their representation theory. Prerequisite: Math. 416.

419. ADVANCED TOPICS IN ALGEBRA. 4 HOURS. May be repeated for credit. Special topics in algebra. Prerequisite: Consent of the instructor.

421. ALGEBRAIC TOPOLOGY I. 4 HOURS. The category of topological spaces and functors, homology of complexes, singular homology theory, Eilenberg-Steenrod axioms, C-W complex, cohomology and cup-products, universal coefficient theorem. Kunneth theorem. Prerequisites: Math. 342 and 357 or the equivalent.

422. ALGEBRAIC TOPOLOGY II. 4 HOURS. Homotopy groups, Hurewicz theorem, Whitehead theorem, fiber spaces, Postnikov sections, obstruction theory, Serre spectral sequence, e-theory, applications. Prerequisite: Math. 421.

423. ALGEBRAIC TOPOLOGY III. 4 HOURS. Freudenthal suspension theorem, stable homotopy theory, cohomology operations, construction and cohomology of Eilenberg-MacLane spaces, structure of the Steenrod algebra, Adams spectral sequence. Prerequisite: Math. 422.

429. ADVANCED TOPICS IN TOPOLOGY. 4 HOURS. May be repeated for credit. Special topics in topology. Prerequisite: Consent of the instructor.

430. REAL ANALYSIS I. 4 HOURS. Set theory, well-ordering cardinal and ordinal numbers, metric spaces, connectedness, compactness, completeness. Prerequisite: Math. 312 or 315 or the equivalent.

431. REAL ANALYSIS II. 4 HOURS. Riemann-Stieltjes integral and its extension, measures and measurable sets, measurable functions, the Lebesque integral. Prerequisite: Math. 430.

432. REAL ANALYSIS III. 4 HOURS. Function spaces, differentiable and nondifferentiable functions, absolutely continuous functions. Prerequisite: Math. 431.

433. INTEGRAL EQUATIONS. 4 HOURS. Fredholm and Hilbert-Schmidt theory and applications, symmetric kernels and orthogonal systems of functions, some types of singular and nonlinear integral equations. Prerequisite: Math. 312 or 315 or the equivalent.

434. TRANSFORM METHODS. 4 HOURS. Mellin and Hankel transforms, multiple Fourier transforms; applications to conduction of heat in solids, to slowing down of neutrons in matter, and to atomic and nuclear physics. Prerequisites: Math. 312 or 315 and Math 331 or 333 or the equivalents.

435. CALCULUS OF VARIATIONS. 4 HOURS. Introductory problems; geodesics, the brachistochrone, minimal surface of revolution. Isoperimetric problems. Geometrical optics, Fermat's principle. Dynamics of particles. Minimum characterization of the eigenvalue-eigenfunction problem. Ritz's method of approximation. Prerequisite: Math. 312 or 315 or the equivalent.

436. FUNCTIONAL ANALYSIS I. 4 HOURS. Topological vector spaces, Banach spaces, Hilbert spaces, Hahn-Banach theorem, interior mapping principle, uniform boundedness principle, applications, approximation and closure theorems. Prerequisite: Math. 432.

437. FUNCTIONAL ANALYSIS II. 4 HOURS. Linear operations on a Banach space, the spectrum and resolvent of a linear operator, compact operators, spectral theorem for compact Hermitian operators on a Hilbert space, integral equations, Sturm-Liouville theory. Prerequisite: Math. 436.

438. FUNCTIONAL ANALYSIS III. 4 HOURS. Spectral theorem for normal operators on a Hilbert space, unbounded operators, semigroups of linear operators, ergodic theorems. H^P spaces of analytic functions, Beurling's theorem on the shift operator, applications. Prerequisite: Math. 437.

440. PARTIAL DIFFERENTIAL EQUATIONS I. 4 HOURS. Classification of equations and characteristics. The Cauchy-Kowalewski theorem. The Cauchy problem for hyperbolic systems in the plane and space of higher dimension. Uniqueness theorems for the Cauchy problem. Prerequisites: Math. 323, 331 or 333, and 342 or 348.

441. PARTIAL DIFFERENTIAL EQUATIONS II. 4 HOURS. Elliptic equations; method of balayage; Dirichlet's principle; fundamental solutions; potential theory; eigenvalue problems. Prerequisite: Math. 440.

442. PARTIAL DIFFERENTIAL EQUATIONS III. 4 HOURS. Partial differential equations of parabolic type. Distributions and weak solutions of partial differential equations. Elliptic boundary value problems. Prerequisites: Math. 436, 441.

445. COMPLEX ANALYSIS I. 4 HOURS. Theorems of Mitlag-Leffler, Weierstrass, and Runge. Entire functions and Hadamard's theorem. Analytic continuation. The Riemann mapping theorem. Prerequisite: Math. 333.

446. COMPLEX ANALYSIS II. 4 HOURS. Continues Mathematics 445. Harmonic and subharmonic functions. The Dirichlet problem. Potential theory and Green's functions. Elliptic functions. Introduction to Riemann surfaces. The Picard theorem. Prerequisite: Math. 445.

447. COMPLEX ANALYSIS III. 4 HOURS. Nevanlinna theory of meromorphic functions. Spaces of analytic functions. Applications to number theory, introduction to several complex variables. Prerequisite: Math. 446.

449. ADVANCED TOPICS IN ANALYSIS. 4 HOURS. May be repeated for credit. Special topics. Prerequisite: Consent of the instructor.

450. PROJECTIVE GEOMETRY I. 4 HOURS. Coordinatization, collineation groups, Desargues' condition, weakened forms of Desargues' condition and corresponding coordinate systems, fundamental theorem of projective geometry. Prerequisite: Consent of the instructor.

451. PROJECTIVE GEOMETRY II. 4 HOURS. Finite planes, free planes, collineations of division ring planes and of free planes, the Lenz-Barlotti classification. Prerequisite: Math. 450.

452. DIFFERENTIAL GEOMETRY I. 4 HOURS. Manifolds, tensor fields, the tensor algebra, the Grassman algebra, exterior differentiation, mappings, transformations of vector fields and differential forms, affine connections, parallelism, the exponential mappings, covariant differentiation. Prerequisite: Consent of the instructor.

453. DIFFERENTIAL GEOMETRY II. 4 HOURS. The Riemannian connection, complete Riemannian manifolds, isometries, curvature, Lie groups. Prerequisite: Math. 452.

454. STRUCTURE OF DIFFERENTIABLE MANIFOLDS I. 4 HOURS. Tangent bundle, vector fields, tensors, differentiable mappings, geodesics, exponential mapping, Whitney embedding theorem, Morse theory. Prerequisites: Credit or registration in Math. 421 and 430.

455. STRUCTURE OF DIFFERENTIABLE MANIFOLDS II. 4 HOURS. De Rham theorem, duality, vector bundles, characteristic classes, Hirzebruch index theorem, almost complete structures, Milnor spheres. Prerequisite: Math. 454.

456. STRUCTURE OF DIFFERENTIABLE MANIFOLDS III. 4 HOURS. Poincare conjecture, structures on manifolds, corbordism theorem, embeddings and immersions, Atiyah-Singer index theorem, Lie groups and Lie algebras, Bott periodicity theorem. Prerequisite: Math. 455.

459. ADVANCED TOPICS IN GEOMETRY. 4 HOURS. May be repeated for credit. Special topics. Prerequisite: Consent of the instructor.

460. RECURSION THEORY I. 4 HOURS. Same as Philosophy 460. Introduction to the theory of recursive functions, Turing machines, and effective computability. Godel's incompleteness theorem. Prerequisite: Math. 344.

461. RECURSION THEORY II. 4 HOURS. Same as Philosophy 461. Classification of recursively enumerable sets, Post's problem, degrees of unsolvability, the arithmetical hierarchy. Prerequisite: Math. 460.

462. METAMATHEMATICS I. 4 HOURS. Same as Philosophy 462. Classical first order logic, axiomatic theories, model theory. Prerequisite: Math. 344.

463. METAMATHEMATICS II. 4 HOURS. Same as Philosophy 463. Incompleteness, undecidability, nondefinability. Prerequisite: Math. 462.

464. METAMATHEMATICS III. 4 HOURS. Same as Philosophy 464. Higher order logic, infinitary logic, proof theory. Prerequisite: Math. 463.

465. ADVANCED SET THEORY I. 4 HOURS. Same as Philosophy 465. Axiomatic set theory, consistency of the continuum hypothesis and the axiom of choice. Prerequisite: Consent of the instructor.

466. ADVANCED SET THEORY II. 4 HOURS. Same as Philosophy 466. Strong infinity axioms. Independence of the continuum hypothesis and the axiom of choice from Zermelo-Fraenkel's axioms. Prerequisite: Math. 465.

469. ADVANCED TOPICS IN MATHEMATICAL LOGIC. 4 HOURS. May be repeated for credit. Same as Philosophy 469. Special topics. Prerequisite: Math. 344.

470. PROBABILITY THEORY I. 4 HOURS. Measure-theoretic aspects of probability theory, characteristic functions, the inversion theorem, the Levy-Cramer continuity theorem, Bochner's theorem, Cramer's theorem and the Herglotz lemma, types of convergence, the Borel-Cantelli lemma, the zero-one law, the law of large numbers, central limit theorems of Lindeberg, Liapunov, and Lindeberg-Feller. Prerequisite: Math. 432.

471. PROBABILITY THEORY II. 4 HOURS. The central limit problem, conditional probability, martingales, random walk and recurrent events, Markov processes with discrete and continuous parameters, general introduction to processes with independent increments and orthogonal increments, stationary processes, least square prediction. Prerequisite: Math. 470.

477. ADVANCED STATISTICAL THEORY. 4 HOURS. Intensive study of fundamental topics: sampling distributions, sufficient statistics; estimation, tests of statistical hypothesis; large sample theory; general theory of linear statistical models; sequential methods. Prerequisite: Math. 372.

480. SCATTERING THEORY I. 4 HOURS. Solutions of the reduced wave equations for scattering of scalar, vector, and dyadic waves; separable and nonseparable problems. Representations: Green's function integrals, complex integrals, inverse distance series, special function series; approximations; geometrical optics and potential theory; applications. Prerequisites: Math. 323, 331, and Phys. 371.

481. SCATTERING THEORY II. 4 HOURS. Representations, theorems, and approximations for many-body problems. Multiple scattering solutions as functionals of single-body functions: integral equations, algebraic equations, series representations, operational closed forms, asymptotic forms. Two-scatterer problems, arbitrary configurations, and periodic sprays. Prerequisite: Math. 480.

482. SCATTERING THEORY III. 4 HOURS. Statistical scattering problems. Scattering by randomly moving distributions. Models for scattering by rough surfaces, gases, and liquids. Relations between scatterer statistics and signal statistics for low-speed distributions. Relativistic scattering problems. Prerequisite: Math. 481.

484.   INTRODUCTION TO APPLIED ANALYSIS. 4 HOURS. Linear vector spaces;
        introduction to Banach space; contraction mapping theorem; existence and
        uniqueness theorems for ordinary differential equations; linear ordinary
        differential equations and systems. Prerequisites: Math. 312 and 341 or 348.

489.   ADVANCED TOPICS IN APPLIED MATHEMATICS. 4 HOURS. May be
        repeated for credit. Special topics in applied mathematics. Prerequisite: Consent
        of the instructor.

490.   COMPUTER PROGRAMMING FOR STUDENTS IN BEHAVIORAL SCIENCES.
        0 HOURS. Seven-week introduction to Fortran IV. Examples from statistics,
        business, and the behavioral sciences. The Computer Center cooperates with
        departments imposing a language requirement in programming in setting
        examinations for this course.

491.   COMPUTER PROGRAMMING FOR STUDENTS IN THE PHYSICAL
        SCIENCES. 0 HOURS. Seven-week introduction to Fortran IV. Examples from
        mathematics, engineering, and the natural sciences. The Computer Center
        cooperates with departments imposing a language requirement in programming in
        setting examinations for this course.

492.   NUMERICAL METHODS IN PARTIAL DIFFERENTIAL EQUATIONS I. 4
        HOURS. Classification of equations and boundary value problems; finite
        difference analogues for parabolic, hyperbolic, and elliptic equations; explicit and
        implicit methods of parabolic and hyperparabolic systems; the method of
        characteristics for hyperbolic equations; stability of initial value problems;
        iterative methods (modern and classical) for elliptic equations; discretization and
        round-off errors. Prerequisites: Math. 323 and 389 or the equivalents.

493.   NUMERICAL METHODS IN PARTIAL DIFFERENTIAL EQUATIONS II. 4
        HOURS. Continues Mathematics 492. Prerequisite: Math. 492.

495.   APPROXIMATION THEORY. 4 HOURS. General approximation theory in
        normed linear spaces with primary emphasis on functions defined on an interval
        and periodic function; existence and uniqueness theorems; characterization of
        Chebyshev approximants; degree of approximation; use of approximations in
        computing. Prerequisites: Math. 312 or 315 and Math. 342 or 348 or the
        equivalents.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Prerequisite:
        Approval of the department.

PHILOSOPHY

Chairman of the Department: Myles Brand

Professors: George T. Dickie, Arthur I. Fine, Daniel J. Morris, Brian K.
Skyrms, Irving Thalberg

Associate Professors: Sandra Bartky, Myles Brand

Assistant Professors: David C. Blumenfeld, Neal K. Grossman, Dorothy Grover, Richard Kraut, Ralf Meerbote, Paul R. Teller, W. Kent Wilson

The department offers work leading to the Master of Arts and the Doctor of Philosophy.

Admission Requirements

Applicants must have a grade-point average of at least 4.00 for the last two years of undergraduate work. Students whose average is below 4.00 but above 3.75 will be considered on an individual basis. An undergraduate major in philosophy is not a requirement for admission.

Applicants should have completed courses in modern formal logic, ethics, history of philosophy, and theory of knowledge or philosophy of science. Students who are admitted with deficiencies must make them up in consultation with the Admissions Committee of the department.

Degree Requirements

Master of Arts

A student must choose at least one course in each of the following areas: history of philosophy; the theory of knowledge, including logic, philosophy of science, and the philosophy of language; and the theory of value, including ethics and aesthetics. The department also requires the student to complete a unified program of 48 quarter hours of graduate study under the direction of an adviser.

Doctor of Philosophy

A full program consists of 16 hours of course work each quarter or a total of 144 quarter hours for the degree. The student must complete all requirements within seven years after entering the program. A student carrying a full program will generally be expected to complete the requirements in fewer than five years. Exceptions will be permitted only under conditions of unusual hardship.

A student progresses toward the Ph.D. in two stages:

1. During the second year, he must take the comprehensive written examination. This examination consists of two parts: (1) an examination on a topic chosen by the student and (2) a general comprehensive examination.

2. After a student has passed the comprehensive examination and has chosen the subject of his dissertation, an appointed doctoral committee will administer a preliminary oral examination to determine whether his research project is feasible and is sufficiently original and serious. The committee may then recommend formal advancement to candidacy for the Ph.D., and a member of the committee will be named to supervise the writing of the dissertation. Upon completion of his dissertation the candidate must defend it in a final oral examination.

In addition to the foregoing, each student must pass an examination in elementary logic.

The language requirement for each student will be decided by a departmental committee of graduate faculty. The determination will be based on a consideration of the area in which the student intends to specialize. In no case will proficiency in more than two languages be required. In those areas where the primary sources are in English, a foreign language may not be required.

A detailed statement of the special departmental requirements for graduate students can be obtained from the Department of Philosophy, 1803 University Hall.

Courses for Graduate and Advanced Undergraduate Students

300. PHILOSOPHY OF SPACE AND TIME. 4 HOURS. Geometry and space, contingent and necessary properties of space and time, the direction and flow of time, effects preceding their causes, Zeno's paradoxes. Prerequisite: Phil. 298.

301. PLATO. 4 HOURS. Selected dialogues. Prerequisite: Phil. 298.

302. ARISTOTLE. 4 HOURS. May be repeated once for credit with permission of the department. Reading and discussion of some of the basic works. Prerequisite: Phil. 298.

303. CHINESE PHILOSOPHY. 4 HOURS. Development of the major Chinese philosophies. Prerequisite: Two courses in philosophy.

304. SEVENTEENTH CENTURY RATIONALISM. 4 HOURS. Same as Religious Studies 304. Selected readings and discussion from the works of Descartes, Spinoza, Leibniz, and others. Prerequisite: Phil. 298.

306. BRITISH EMPIRICISM. 4 HOURS. Selected readings from the works of such philosophers as Locke, Berkeley, and Hume. Prerequisite: Phil. 298.

308. KANT. 4 HOURS. Kant's philosophy, with emphasis on the *Critique of Pure Reason*. Prerequisite: Phil. 304 or 306 or 330.

309. TOPICS IN THE HISTORY OF ETHICS. 4 HOURS. Intensive treatment of either an important person, such as Kant, or theory (utilitarianism) in the history of ethics. Specific topics are announced. Prerequisite: Phil. 218.

310. NINETEENTH CENTURY AND EARLY TWENTIETH CENTURY THOUGHT. 4 HOURS. May be repeated for credit with the approval of the department. Studies of selections from the writings of Hegel, Schelling, Fichte, Schopenhauer, Marx and Engels, J.S. Mill, Nietzsche, McTaggart, Green, Bradley, Peirce, Perry, and others. Prerequisite: Phil. 298.

311. INDUCTIVE LOGIC. 4 HOURS. Traditional and contemporary problems of induction. Inductive logic and the theory of probability. Prerequisite: Phil. 298.

312. RECENT AND CONTEMPORARY PHILOSOPHY: ANALYSIS AND LOGICAL EMPIRICISM. 4 HOURS. Developments in recent philosophy which have their roots in the study of logic and language, such as logical atomism, positivism, and analytical philosophy. Prerequisite: Phil. 298.

313. THE CLAIMS OF SCIENCE AND RELIGION. 4 HOURS. Same as Religious Studies 313. Convergence and conflict between the results of science and the claims of religion; similarities and differences between their methods of inquiry. Prerequisites: Phil. 214 and one other course in philosophy.

314. RECENT AND CONTEMPORARY PHILOSOPHY: PHENOMENOLOGY AND EXISTENTIAL PHILOSOPHY. 4 HOURS. Important contributions to the phenomenological movement. Selected readings from Husserl, Heidegger, Jaspers, Sartre, Merleau-Ponty, and others. Prerequisite: Two courses in philosophy.

315. MODERN CHINESE PHILOSOPHY. 4 HOURS. Development of recent Chinese systems of philosophy. Prerequisite: Phil. 303.

321. INTRODUCTION TO FORMAL LOGIC. 4 HOURS. Not open to students with credit or current enrollment in Philosophy 211. Four meetings per week coincide with Philosophy 211 (see undergraduate catalog for description of Philosophy 211). One additional meeting per week is devoted to an introduction to elementary set theory plus extra topics related to work in Philosophy 211.

322. PROBLEMS IN THE FOUNDATIONS OF LOGIC AND MATHEMATICS. 4 HOURS. Survey of selected problems. Prerequisite: Phil. 211 or the equivalent.

330. THEORY OF KNOWLEDGE. 4 HOURS. The grounds of belief; the nature of truth; evidence and proof; other related epistemological problems. Prerequisites: Phil. 230 and 298.

332. ETHICS AND VALUE THEORY. 4 HOURS. Same as Religious Studies 332. The nature of moral judgments and moral reasoning; ethics as a normative discipline; definitions of "value"; ethical judgments as a kind of value judgment. Prerequisite: Two courses in philosophy, one of which must be a 200-level course.

334. AESTHETICS. 4 HOURS. The aesthetic object. Form, representation, and meaning in art. Art and knowledge. Prerequisite: Phil. 298.

336. **TOPICS IN METAPHYSICS. 4 HOURS.** Systematic analysis of selected metaphysical concepts, such as existence, substance and attribute, universals and particulars, change, identity, space and time, and the individual. Recent and traditional points of view are considered. Prerequisites: Phil. 236 and 298.

338. **PHILOSOPHICAL ANALYSIS OF THE CONCEPT OF MIND. 4 HOURS.** Presuppositions and logical interconnections involved in the use of such terms as "mind," "thoughts," "action," "intention," and "will." Prerequisite: Phil. 298.

340. **PHILOSOPHY OF LANGUAGE. 4 HOURS.** Philosophical and logical problems concerned with the nature of meaning and the structure of language. Prerequisites: Phil. 211, 240, and 298.

341. **PHILOSOPHICAL PROBLEMS IN THE SOCIAL SCIENCES. 4 HOURS.** Critical examination of some important philosophical problems in the foundations of the social sciences: general methodological problems or specific philosophical problems arising from some specific theories, such as decision theory, theory of learning, information theory, or other theories. Exact content varies from year to year. Prerequisite: Two courses in philosophy.

343. **FORMAL LOGIC I. 4 HOURS.** Same as Mathematics 343. Propositional logic, logic of quantifiers, and identity and completeness. Prerequisite: Consent of the instructor; none for mathematics majors.

344. **FORMAL LOGIC II. 4 HOURS.** Same as Mathematics 344. Continues Philosophy 343. Mathematical analysis of decidability and computability. Arithmetization of syntax. Incompleteness and undefinability theorems. Introduction to axiomatic set theory. Prerequisite: Phil. 343.

345. **PHILOSOPHICAL PROBLEMS OF THE SCIENCES. 4 HOURS.** May be repeated for credit with the permission of the department. Reading and discussion of selected works on the aims and methods of science, the status of scientific theories, natural laws and theoretical entities, and the nature of explanation. Prerequisite: Phil. 298.

347. **PHILOSOPHY OF LAW. 4 HOURS.** Topics vary. Emphasis may be on systems of criminal and civil laws; distinctions between legislation and judicial decision making; moral sources and responsibility; *mens rea*; theories of punishment; civil disobedience; human rights and civil rights; civil liberties. The writings of philosophers. Landmarks of jurisprudence and important court cases may be studied. Prerequisite: Phil. 298.

351. **PROBLEMS IN THE PHILOSOPHY OF MATHEMATICS. 4 HOURS.** Intensive study of a particular problem or nexus of problems in the philosophy of mathematics. Prerequisite: Phil. 298.

398. **SENIOR SEMINAR. 4 HOURS.** Individual research projects to be reported to the seminar. Required for graduate work in philosophy. Prerequisites: Senior standing, Phil. 201, 203, 211, and at least one 300-level course.

399.   INDEPENDENT STUDY. 1 TO 8 HOURS. Independent study, under the
       supervision of a staff member, of a topic not covered in the regular curriculum.
       The course is offered at the request of the student and only at the discretion of
       the staff members concerned. Prerequisite: Approval of the department.

Courses for Graduate Students

401.   SEMINAR: TOPICS IN ANCIENT PHILOSOPHY. 6 HOURS. May be repeated
       once for credit with the approval of the department. Two sections may be taken
       concurrently when topics vary. Intensive study of selected topics.

403.   SEMINAR ON MEDIEVAL PHILOSOPHY. 6 HOURS. May be repeated once for
       credit with the approval of the department. Two sections may be taken
       concurrently when topics vary. Persistent problems in the philosophy of the
       Middle Ages.

405.   SEMINAR: TOPICS IN MODERN PHILOSOPHY. 6 HOURS. May be repeated
       once for credit with the approval of the department. Two sections may be taken
     • concurrently when topics vary. Intensive analysis of the work of one important
       philosopher or philosophical movement between 1600 and 1900.

407.   SEMINAR: TOPICS IN CONTEMPORARY PHILOSOPHY. 6 HOURS. May be
       repeated once for credit with the approval of the department. Two sections may
       be taken concurrently when topics vary. Intensive analysis of the work of one
       important philosopher or philosophical movement of the twentieth century.

411.   SEMINAR ON RECENT ETHICAL THEORY. 6 HOURS. May be repeated once
       for credit with the approval of the department. Two sections may be taken
       concurrently when topics vary. Intensive study of selected topics.

413.   SEMINAR ON PHILOSOPHICAL TOPICS IN LOGIC. 6 HOURS. May be
       repeated once for credit with the consent of the instructor. Two sections may be
       taken concurrently when topics vary.

415.   SEMINAR ON METAPHYSICS. 6 HOURS. May be repeated once for credit with
       the approval of the department. Two sections may be taken concurrently when
       topics vary. Intensive study of selected topics.

417.   SEMINAR ON THE PHILOSOPHY OF SCIENCE. 6 HOURS. May be repeated
       once for credit with the approval of the department. Two sections may be taken
       concurrently when topics vary. Intensive study of selected topics.

419.   SEMINAR ON THE PHILOSOPHY OF LANGUAGE. 6 HOURS. May be
       repeated once for credit with the approval of the department. Two sections may
       be taken concurrently when topics vary. Intensive study of selected topics.

421.   SEMINAR ON THE THEORY OF KNOWLEDGE. 6 HOURS. May be repeated
       once for credit with the approval of the department. Two sections may be taken
       concurrently when topics vary. Selected topics in the contemporary theory of
       knowledge.

423. SEMINAR ON AESTHETICS. 6 HOURS. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.

460. RECURSION THEORY I. 4 HOURS. Same as Mathematics 460. Introduction to the theory of recursive functions, Turing machines, and effective computability. Godel's incompleteness theorem. Prerequisite: Phil. 344.

461. RECURSION THEORY II. 4 HOURS. Same as Mathematics 461. Classification of recursively enumerable sets, Post's problem, degrees of unsolvability, the arithmetical hierarchy. Prerequisite: Phil. 460.

462. METAMATHEMATICS I. 4 HOURS. Same as Mathematics 462. Classical first order logic, axiomatic theories, model theory. Prerequisite: Phil. 344.

463. METAMATHEMATICS II. 4 HOURS. Same as Mathematics 463. Incompleteness, undecidability, nondefinability. Prerequisite: Phil. 462.

464. METAMATHEMATICS III. 4 HOURS. Same as Mathematics 464. Higher order logic, infinitary logic, proof theory. Prerequisite: Phil. 463.

465. ADVANCED SET THEORY I. 4 HOURS. Same as Mathematics 465. Axiomatic set theory, consistency of the continuum hypothesis, and the axiom of choice. Prerequisite: Consent of the instructor.

466. ADVANCED SET THEORY II. 4 HOURS. Same as Mathematics 466. Strong infinity axioms. Independence of the continuum hypothesis and the axiom of choice from Zermelo-Fraenkel's axioms. Prerequisite: Phil. 465.

469. ADVANCED TOPICS IN MATHEMATICAL LOGIC. 4 HOURS. May be repeated for credit. Same as Mathematics 469. Special topics. Prerequisite: Phil. 344.

479. SEMINAR: THEORETICAL, HISTORICAL, AND PHILOSOPHICAL ISSUES IN PSYCHOLOGY. 2 HOURS. Same as History 479 and Psychology 479. May be repeated. Systematic review of special topics; emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.

483. INDEPENDENT STUDY. 2 TO 8 HOURS. Topics and plan of study must be approved by the candidate's adviser and by the staff member who directs the work.

490. SEMINAR ON THE TEACHING OF PHILOSOPHY. 1 HOUR. May be repeated for credit. Discussion of problems connected with the teaching of introductory courses in philosophy. Required of all graduate students in philosophy unless excused by the department. All teaching assistants will be required to enroll during the tenure of their assistantships.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit.

PHYSICS

Professors: Swaminatha Sundaram, Head of the Department; Seymour Bernstein, Arnold R. Bodmer, James W. Garland, James S. Kouvel, Edward B. McNeil, Antonio Pagnamenta, R. Curtis Retherford, Herman B. Weissman, Lester Winsberg

Associate Professors: Stanley Aks, Richard A. Carhart, Helmut Claus, Alan S. Edelstein, Howard S. Goldberg, Gloria A. Hoff, Stephen J. Krieger, Arthur L. Licht, Donald W. McLeod, Seymour Margulies, William J. Otting, John N. Pappademos, David S. Schreiber, Ram R. Sharma, Julius Solomon, David J. Vezzetti

Assistant Professors: Larry L. Abels, Robert J. Abrams, Jack A. Kaeck, Ben Varga

The department offers graduate work leading to the Master of Science and the Doctor of Philosophy with the following areas of specialization:

Atomic and Molecular Physics—oscillator strengths, vibrational and rotational spectra, high temperature properties, lasers, vacuum UV.

High Energy Physics—K^o decays, CP violation, scattering, weak and strong interactions, resonances, symmetries, field theory, Regge poles.

Nuclear Physics—nuclear structure, hypernuclei, nuclear potentials, deformed nuclei.

Solid State Physics—magnetic resonance and static susceptibility, specific heat, electron tunneling and transport properties of metals, superconductors, and insulators; studies at ultra-low temperatures; optical and dielectric properties.

Theoretical Physics—atomic-molecular energies; superconductivity, dispersion relations, lattice properties, electronphonon interactions, crystal fields, quantum hydrodynamics; nuclear structure and hypernuclei; field theory, particle interactions, resonances and scattering; statistical mechanics.

Admission Requirements

In addition to meeting the requirements of the Graduate College applicants must have 30 quarter hours (20 semester hours) of courses in physics beyond the level of general physics, including Physics 301, 302, 321, and 341, or their equivalents, and a grade-point average of at least 3.75 for the last 90 quarter hours of undergraduate work. Applicants with grade-point

averages below 3.75 but above 3.50 may be admitted under special circumstances. Applicants who have majored in fields other than physics and who meet the other academic requirements may be considered for admission, but they will be required to take the necessary undergraduate courses without credit in order to prepare themselves for successful participation in graduate work.

Degree Requirements

Master of Science

Satisfactory completion of 48 quarter hours of course work is required with at least 24 hours in physics, including Physics 401, 402, 411, 412, and 441 or equivalent courses. It is strongly recommended that Physics 403, 413, and 461 be included. A thesis is optional. If it is elected, a maximum of 12 quarter hours may be allowed as a combined total for Physics 497, Independent Study, and Physics 499, Thesis Research; if a thesis is not elected, a maximum of 8 quarter hours may be allowed for Physics 497. [1]

Doctor of Philosophy

The minimum requirements for the Ph.D. in physics are: satisfactory completion of at least 144 quarter hours of approved course work beyond the bachelor's degree, including the 8 courses required or recommended for the M.S.; a satisfactory written and oral qualifying examination covering mechanics, electrodynamics, quantum mechanics, statistical physics and elementary modern physics at the level of advanced undergraduate courses, the graduate courses required for the M.S. and Physics 461; a satisfactory preliminary examination after the completion of all course work; and a satisfactory final oral examination on a thesis acceptable to the examining committee. A maximum of 48 quarter hours is allowed for Physics 499; a combined maximum of 64 quarter hours may be allowed for Physics 497 and Physics 499.

There is no foreign language proficiency requirement.[1]

[1] For the information on the grading system refer to the general Graduate College requirements.

Courses for Graduate and Advanced Undergraduate Students

301.   ELECTRICITY AND MAGNETISM I. 4 HOURS. Credit is not given to graduate physics majors. Vector calculus; electrostatic potential and fields in vacuum and

material media; energy concepts; boundary value problems. Prerequisites: Phys. 114 and Math. 321.

302.   ELECTRICITY AND MAGNETISM II. 4 HOURS. Credit is not given to graduate physics majors. Magnetostatics; vector potential; magnetic materials; time-varying fields and electromagnetic induction; Maxwell's equations. Prerequisite: Phys. 301.

303.   ELECTRICITY AND MAGNETISM III. 4 HOURS. Propagation of electromagnetic waves; reflection, refraction, and dispersion; guided waves; radiation; selected topics. Prerequisite: Phys. 302.

304.   ELECTRONICS I. 4 HOURS. Theory of electronic devices, linear and nonlinear analysis, applications of vacuum and semiconductor devices to circuits, amplifiers, biasing, feedback, oscillators, and special circuits. Prerequisite: Phys. 301. Physics 302 and 303 are recommended.

305.   ELECTRONICS II. 4 HOURS. Pulse-shaping networks, logic circuits, control circuits, distributed amplifiers, special problems of transducers, special signal-to-noise techniques. Prerequisite: Phys. 304.

321.   QUANTUM MECHANICS I. 4 HOURS. The basic theory of the mechanics governing microscopic systems. Wave functions; probability density; operators; the Schrodinger equation with examples in one and three dimensions. Prerequisites: Phys. 114, 221 or the approval of the department, and Math. 220. Credit or registration in Mathematics 310 is recommended.

322.   QUANTUM MECHANICS II. 4 HOURS. Mathematical structure of quantum mechanics; observables for a quantum state; angular momentum; perturbation theory; the Born approximation; the variational method; transition probabilities. Prerequisite: Phys. 321. Credit or registration in Mathematics 311 is recommended.

323.   ELEMENTARY SOLID STATE PHYSICS. 4 HOURS. Crystal structure, thermal and dielectric properties of solids, free electron model of metals, band theory, semiconductor physics, dislocations and strength of solids. Individual projects are required. Prerequisite: Phys. 322.

331.   NUCLEAR PHYSICS. 4 HOURS. Natural and artificial radioactivity, equipment for studying and producing high-energy particles, nuclear disintegrations, interaction of nuclear particles with each other and with matter, cosmic rays, mesons, recent developments in high-energy physics. Individual projects are required. Prerequisite: Phys. 321.

332.   INTRODUCTION TO PARTICLE PHYSICS. 4 HOURS. Properties of the known elementary particles and their basic interactions. Accelerators and detectors. The discrete conservation laws with applications. Antiparticles, strangeness. Prerequisites: Phys. 321 and 322 or the approval of the department.

341.   THEORETICAL MECHANICS I. 4 HOURS. Credit is not given to graduate physics majors. Motion of a particle in one, two, and three dimensions, Kepler's

laws and planetary motion, scattering of particles, conversion between laboratory and center of mass coordinate systems, conservation laws, motion of a rigid body in two dimensions. Individual projects are required. Prerequisites: Phys. 114 or approval of the department; Math. 220.

342. THEORETICAL MECHANICS II. 4 HOURS. Statics of extended systems, moving coordinate frames, fictitious forces and conservation laws, special theory of relativity, mechanics of continuous media. Individual projects are required. Prerequisite: Phys. 341.

343. THEORETICAL MECHANICS III. 4 HOURS. Rigid-body motion in three dimensions, motion in gravitional fields, generalized coordinated and Lagrange and Hamilton equations, equations of constraint, small-vibration theory. Individual projects are required. Prerequisite: Phys. 342.

361. THERMODYNAMICS. 4 HOURS. Thermodynamic variables, equilibrium, zeroth law of thermodynamics, isolated systems, the first law, Kelvin and Clausius statements of second law, Clausius inequality, irreversible processes, thermodynamic potentials, Maxwell relations, stability criteria, equations of state, Clausius-Clapeyron equation, multicomponent systems, the third law, selected applications to physical systems. Prerequisite: Phys. 114.

362. STATISTICAL PHYSICS. 4 HOURS. Kinetic theory of dilute gases, elementary statistical concepts, equilibrium between interacting systems; temperature, entropy, statistical calculation of thermodynamic quantities, the microcanonical and canonical ensembles, quantum statistics of ideal gases, selected applications to physical systems. Prerequisite: Phys. 361.

366. INTRODUCTION TO THE MATHEMATICAL METHODS OF THEORETICAL PHYSICS I. 4 HOURS. Same as Mathematics 366. The traditional mathematical methods of theoretical physics from an intuitive point of view. Applications to problem solving in electrostatics and classical and quantum mechanics. Matrices and linear transformations, Fourier analysis, the partial differential equations of physics, and Sturm-Liouville theory. Introduction to special functions frequently encountered in physics. Prerequisites: Math. 310, 321; Phys. 303, 322, 342.

367. INTRODUCTION TO THE MATHEMATICAL METHODS OF THEORETICAL PHYSICS II. 4 HOURS. Same as Mathematics 367. The traditional mathematical methods of theoretical physics from an intuitive point of view. Applications to problem solving in electrostatics, electrodynamics, and classical and quantum mechanics. The special functions frequently encountered in physics and their use in the solution of boundary value problems, power series solutions, Green's functions, contour integral representations, and additional uses. Prerequisite: Phys. 366.

371. LIGHT(WAVE OPTICS). 4 HOURS, LECTURE AND LABORATORY; 2 HOURS, LECTURE ONLY. Wave propagation and Maxwell's equations, interference and interferometers, gratings, circular aperture, echelon, resolving power. Prerequisites: Phys. 114 and credit or registration in Math. 220.

372.   LIGHT (MODERN OPTICS) I. 4 HOURS, LECTURE AND LABORATORY; 2
       HOURS, LECTURE ONLY. Crystals, polarized light, optics of metals, quantum
       theory of radiation, transition probability and oscillator strength, dispersion and
       scattering theory. Prerequisite: Phys. 371.

373.   LIGHT (MODERN OPTICS) II. 4 HOURS. Individual projects are required.
       Gaussian optics and general laws, special optical systems and applications. Image
       formation, finite image-error theory, spot diagrams. Necessary mathematical tools
       for Fourier analysis and transfer functions. Prerequisite: Phys. 372.

381.   MODERN EXPERIMENTAL PHYSICS I. 4 HOURS, LECTURE AND
       LABORATORY; 1 HOUR, LECTURE ONLY. Techniques and experiments in the
       physics of atoms, atomic nuclei, molecules, the solid state, and other areas of
       modern physical research. Prerequisites: Phys. 304 and 331.

382.   MODERN EXPERIMENTAL PHYSICS II. 4 HOURS. Continues Physics 381.
       Lecture and laboratory. Prerequisite: Phys. 381.

391.   PHYSICS SEMINAR. 1 TO 4 HOURS. Topics, to be arranged, cover recent
       developments in modern physics suitable for advanced undergraduate and
       graduate students. Prerequisites: Senior standing and approval of the department.

392.   PHYSICS RESEARCH. 2 TO 4 HOURS. Research under the close supervision of
       a faculty member. Prerequisites: Senior standing and approval of the department.

393.   SPECIAL PROBLEMS. 2 TO 4 HOURS. Special problems or reading in modern
       physics under individual arrangement with a faculty member. Prerequisites:
       Senior standing and consent of the instructor.

Courses for Graduate Students

401.   ELECTRODYNAMICS I. 4 HOURS. Maxwell's equations; static and
       time-dependent fields; boundary value problems; wave propagation. Prerequisite:
       Phys. 303 or approval of the department.

402.   ELECTRODYNAMICS II. 4 HOURS. Classical theory of radiation; radiation
       reaction; special relativity; covariant formulation of electrodynamics.
       Prerequisite: Phys. 401 or approval of the department.

403.   ELECTRODYNAMICS III. 4 HOURS. Lagrangian formulation of
       electrodynamics; action principles; special topics in electromagnetic theory.
       Prerequisite: Phys. 402 or approval of the department.

411.   QUANTUM MECHANICS I. 4 HOURS. Wave functions, uncertainty principle and
       Schrodinger equation, one- and three-dimensional one-particle problems,
       approximate methods. Prerequisite: Phys. 322 or approval of the department.

412.   QUANTUM MECHANICS II. 4 HOURS. Operators and Hilbert space
       formulation, symmetries and conservation laws, angular momentum and

rotations, coupling of angular moments, spherical tensors, scattering, phase shifts, Born series, scattering in Coulomb field, inelastic scattering. Prerequisite: Phys. 411 or approval of the department.

413. QUANTUM MECHANICS III. 4 HOURS. Introduction to formal theory of scattering, S-matrix, time-dependent and independent formulations of scattering, introduction to relativistic quantum mechanics, Klein-Gordon and Dirac equations, introduction to quantum field theory, electromagnetic transitions, particles and antiparticles. Prerequisite: Phys. 412 or approval of the department.

414. ADVANCED QUANTUM MECHANICS I. 4 HOURS. Canonical quantum field theory, quantization of the electromagnetic field, the Dirac field, the scalar and pseudoscalar meson fields, the interactions of quantum fields with classical fields. Prerequisite: Phys. 413 or approval of the department.

415. ADVANCED QUANTUM MECHANICS II. 4 HOURS. Interacting quantum fields, the S-matrix, the Dyson expansion and diagrams, applications to problems in quantum electrodynamics, renormalization and its physical interpretation. Prerequisite: Phys. 414 or approval of the department.

417. MANY-BODY THEORY I. 4 HOURS. Quantum theory of many-particle systems at zero temperature; molecular and self-consistent fields; canonical transformations; the quasiparticle; Green's functions; perturbation theory; Feynmann diagrams; simple applications to Fermi and Bose systems. Prerequisites: Phys. 414, 461.

418. MANY-BODY THEORY II. 4 HOURS. Functional integral formalism; elementary excitations and physical interpretation of Green's functions; Landau theory; thermal Green's functions and finite temperature perturbation theory; reaction matrix methods; applications to Fermi and Bose systems. Prerequisite: Phys. 417.

421. ATOMIC AND MOLECULAR PHYSICS I. 4 HOURS. Hydrogen atom and one-electron systems, helium atom, self-consistent field theory, alkali spectra, vector model, Zeeman and Stark effects, fine and hyperfine structure, collisions, ionization. Prerequisite: Phys. 322 or approval of the department.

422. ATOMIC AND MOLECULAR PHYSICS II. 4 HOURS. Rotation and vibrational energies of diatomic molecules, potential curves, electronic transitions and transition moments, intensities, thermodynamic properties, applications. Prerequisite: Phys. 322 or approval of the department.

423. ATOMIC AND MOLECULAR PHYSICS III. 4 HOURS. Structure and symmetry of molecules, vibrational and rotational spectra, experimental infrared and Raman spectra, chemical bonding, molecular interactions, molecular collisions, intermolecular potentials, relaxation phenomena. Prerequisite: Phys. 322 or approval of the department.

425. SOLID STATE PHYSICS I. 4 HOURS. Crystal structure, X-ray methods, crystal forces, lattice theory, vibrations, heat conductivity. Prerequisite: Phys. 323 or approval of the department.

426. SOLID STATE PHYSICS II. 4 HOURS. Electric and magnetic properties of solids, free-electron model of metals, quantum statistics, band theory, order-disorder theory. Prerequisite: Phys. 425 or approval of the department.

427. SOLID STATE PHYSICS III. 4 HOURS. Semiconductors, ferromagnetism and antiferromagnetism, superconductivity, lattice vacancies, color centers, excitons, luminescence. Prerequisite: Phys. 426 or approval of the department.

428. QUANTUM THEORY OF SOLIDS I. 4 HOURS. Introduction to quantum mechanics of noninteracting particles in a periodic potential, band structure of solids, optical properties of solids, dynamics of electrons in a magnetic field and a crystal potential. Prerequisites: Phys. 412, 427, and 461, or approval of the department.

429. QUANTUM THEORY OF SOLIDS II. 4 HOURS. The electron-phonon interaction, collective excitations in solids, phonons, plasmons, polarons, magnons, excitons, quasiparticles, Landau theory of the Fermi liquid, the Hartree-Foch, RPA, and SCF approximations, generalized susceptibility, introduction to Green's functions, and diagrammatic techniques in solids. Prerequisite: Phys. 428 or approval of the department.

430. QUANTUM THEORY OF SOLIDS III. 4 HOURS. May be repeated for credit by arrangement with the department. Topics will vary from year to year. Special topics in the modern theory of solids, superconductivity, ferromagnetism, liquid helium, theory of alloys, theory of liquids, theory of defects in semiconductors, applications of group theory to solid state physics and others. Prerequisite: Phys. 429 or approval of the department.

431. ELEMENTARY PARTICLE AND NUCLEAR PHYSICS I. 4 HOURS. Two-nucleon system: properties of the deuteron, nucleon-nucleon scattering, nuclear forces. Properties of pions and pion-nucleon scattering, other nonstrange mesons; introduction to strange particles and higher symmetries. Prerequisite: Phys. 412 or approval of the department.

432. ELEMENTARY PARTICLE AND NUCLEAR PHYSICS II. 4 HOURS. General properties of nuclei: sizes, binding energies, stability, saturation. Introduction to nuclear models and structure. Beta decay and weak interactions. Prerequisite: Phys. 431 or approval of the department.

433. NUCLEAR PHYSICS I. 4 HOURS. Review of two-nucleon system and nuclear forces, nuclear models and nuclear spectroscopy. Individual-particle model, collective model, particle-hole excitations, pairing, electromagnetic interactions. Prerequisites: Phys. 413 and 432, or approval of the department.

434. NUCLEAR PHYSICS II. 4 HOURS. Nuclear reactions: compound nucleus, optical model, direct reactions. Nuclear forces and nuclear structure; light nuclei, nuclear many-body problem; nucleon-nucleus scattering at high energies. Interactions of particles other than nucleons with nuclei. Prerequisite: Phys. 433 or approval of the department.

435. ELEMENTARY PARTICLE PHYSICS I. 4 HOURS. Fields and invariance principles, relativistic kinematics and scattering, strong and electromagnetic interactions of nonstrange particles. Pions and nucleons, resonances, introduction to dispersion relations, one-particle exchanges, electromagnetic form factors. Prerequisites: Phys. 413 and 432, or approval of the department.

436. ELEMENTARY PARTICLE PHYSICS II. 4 HOURS. Strong interactions of strange particles; higher symmetries; weak interactions of nonstrange and of strange particles. Prerequisite: Phys. 435 or approval of the department.

441. CLASSICAL MECHANICS. 4 HOURS. Variational principles; Lagrange and Hamilton equations; Hamilton-Jacobi theory; rigid body motion; small oscillations; continuous systems and fields. Prerequisite: Phys. 343 or approval of the department.

445. INTRODUCTION TO GENERAL RELATIVITY. 4 HOURS. Deficiencies of Newtonian gravitational theory, principle of equivalence, the metric field and geodesics, tensor analysis and differential geometry, Einstein's equations and the action principle, the energy-momentum pseudotensor, gravitational fields and waves. Prerequisites: Phys. 402 and 441 or approval of the department.

451. PHYSICS TEACHING I. 4 HOURS. Seminars on various methods and approaches to classroom teaching of physics at different college levels. Individual student design and construction of a classroom demonstration. Supervised practice teaching in the physics classroom. Prerequisite: Graduate standing or approval of the department.

452. PHYSICS TEACHING II. 4 HOURS. Seminars on methodology and problems associated with teaching college physics in the laboratory. Individual student design and construction of an experiment in introductory physics. Supervised practice teaching in the physics laboratory. Prerequisite: Phys. 451 or approval of the department.

453. PHYSICS TEACHING III: CURRENT PRACTICES, PROBLEMS, AND TRENDS. 4 HOURS. Seminars on current practices and trends in teaching physics at the college and precollege levels. Lectures on educational problems in an urban environment, educational testing methods, modern teaching instruments, and other special topics. Prerequisite: Graduate standing or approval of the department.

461. STATISTICAL MECHANICS. 4 HOURS. Classical and quantum-statistical mechanics; Maxwell, Bose, and Fermi statistics; ensemble theory; imperfect gas; selected applications. Prerequisite: Phys. 361 or approval of the department.

481. MATHEMATICAL METHODS OF PHYSICS I. 4 HOURS. Introduction to the linear methods of mathematical physics from the modern point of view. Mathematical foundations of quantum theory; classical problems of differential equations. Prerequisite: Approval of the department.

482. MATHEMATICAL METHODS OF PHYSICS II. 4 HOURS. Applications of linear analysis to ordinary and partial differential equations and integral equations.

Properties of classical special functions and generalized functions. Prerequisite: Phys. 481 or approval of the department.

491. GRADUATE SEMINAR. 1 TO 2 HOURS. May be repeated for a total of 6 hours. Seminars are organized in areas of research activity within the department and cover recent contributions to the literature and research in progress. Students, faculty, and scientists from other institutions make presentations. Prerequisites: Phys. 411 and 412.

497. INDIVIDUAL STUDY. 2 TO 4 HOURS. Special topics. Outside reading and term paper will be assigned by special arrangement with the department and faculty. Prerequisite: Approval of the department.

498. SPECIAL TOPICS IN MODERN PHYSICS. 1 TO 4 HOURS. Student may enroll in more than one section of this course concurrently. Lectures on topics of current interest. Subjects are announced. Prerequisites: Phys. 411 and 412.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Prerequisite:
  •   Approval of the department.

POLITICAL SCIENCE

Professors: David C. Leege, Head of the Department; Hollis W. Barber, Twiley W. Barker, Jr., Doris A. Graber, Richard M. Johnson, Boyd R. Keenan, Byung-Chul Koh, Milton Rakove

Associate Professors: George D. Beam, Don R. Bowen, Thomas J. Cook, Eugene Eidenberg, Catherine Kelleher, Lyman A. Kellstedt, Frank P. Scioli, Dick W. Simpson, Frank Tachau

Assistant Professors: George I. Balch, Elinor R. Bowen, Ann M. Heinz, Peter R. Knauss

Admission Requirements

An applicant must have a degree from an accredited institution of higher learning and a B average for the last two years of undergraduate work. If his grade-point average is below 4.00 but above 3.75, he will be considered in exceptional cases.

An applicant generally must present a Bachelor of Arts with either a major in political science or a minimum of 20 quarter hours in political science; or he may petition to be admitted by the department.

Applications for entrance with advanced graduate standing will be considered on the basis of individual preparation and merit.

All applicants are required to take the Aptitude Test and the Advanced Political Science Test of the Graduate Record Examination. Information about this examination can be obtained from the head of the Department of Political Science. Performance on this examination, undergraduate academic

record, and letters of recommendation from former teachers are the three principal kinds of evidence considered in making decisions about admission and the awarding of assistantships. It is particularly advantageous, therefore, for the prospective applicant to take this examination in the fall of his senior year.

Degree Requirements

The department offers courses leading to the Master of Arts; the mininum requirements are:

1. 48 quarter hours beyond the bachelor's degree for students electing the nonthesis option and 36 quarter hours (exclusive of thesis credit) for students electing to write a thesis. A maximum of two courses may be taken outside the department.

2. Political Science 400 (8 hours), Power in Urban Areas: Introduction to Political Analysis, or the equivalent.

3. A reading knowledge of French, German, Russian, or Spanish or demonstrated competence in statistics or another acceptable research tool.

4. Three quarters of residence, not necessarily consecutive, with 24 quarter hours taken in residence.

5. For the nonthesis option, at least 24 hours of course work at the 400 level. These students must also write an examination covering the area of specialization and other work taken during the M.A. program.

6. For the thesis option, a thesis, for which 12 hours of thesis research credit is awarded, and an oral examination thereon.

Courses for Graduate and Advanced Undergraduate Students

301. EDUCATIONAL POLICY IN URBAN AMERICA. 4 HOURS. Same as Education 301. Examination of selected urban phenomena in relation to educational bureaucracies and school socialization processes. Emphasis on historical investigation of strategies for protest and change employed by ghetto populations; conditions which fostered these strategies; responses of schools and other target institutions; social-philosophical analysis of ideologies supporting both protest and response. Prerequisites: One course in the social foundations of education or the equivalent and consent of the instructor.

305. LOCAL POLITICAL DECISION MAKING. 4 HOURS. A research seminar. The problem of identifying and investigating political decisions in a major urban area like Chicago; an attempt is made to apply different theories of decision making to local politics. Prerequisites: PolS. 120 or 150 and consent of the instructor.

306. GHETTO POLITICS. 4 HOURS. Same as Black Studies 306. Analysis of the political impact of the ghetto on local, state, and national political systems; the impotency of the ghetto voter; the ghetto politician; ghetto riots as political protest; the ghetto and presidential politics. Prerequisite: Three courses in political science, American history, or sociology.

307. URBAN POLITICS SEMINAR. 4 HOURS. Analysis of the structure and dynamics of political parties and organizations in urban areas. Intensive study of the power structure, strength, and weakness of the Democratic and Republican parties in urban areas, using Chicago and its surburbs as a laboratory. Prerequisites: PolS. 205 and consent of the instructor.

311. STUDIES IN URBAN PUBLIC POLICIES. 4 HOURS. The problems of governing metropolitan areas; special emphasis on evolving patterns of cooperation among governments in metropolitan areas, such as metropolitan federalism, city-county consolidation, councils of governments, and regional planning commissions. Prerequisite: PolS. 120 or 205.

315. LEGISLATURES AND LEGISLATION. 4 HOURS. The legislative function in government; structure and organization of American legislatures, national, state, and local; party organization in legislatures; legislative procedure; pressure groups and lobbying; relation of legislature to other branches of government; problems of legislative reorganization. Prerequisite: PolS. 120 or 150 or 151.

316. THE PRESIDENT AND CONGRESS. 4 HOURS. Analysis of the relationship of the President and Congress; problems involved in the formulation and execution of public policy. Prerequisite: PolS. 120 or 150 or 151.

317. INTERGOVERNMENTAL RELATIONS. 4 HOURS. The origin and evolution of the American federal system; federal-state constitutional relationships; intergovernmental fiscal relations; the political cultures; interstate relations; regionalism, state-local relations, interlocal relations and cooperative federalism in functional areas. Prerequisites: PolS. 150 or 151 and 205 or 212.

318. SCIENCE, TECHNOLOGY, AND PUBLIC POLICY. 4 HOURS. The impact of science and technology on government policy in the United States. Responses of the national executive and legislative branches of government; intergovernmental aspects of technological advances. Prerequisites: PolS. 150 or 151 and one advanced political science course.

319. THE PUBLIC ADMINISTRATION OF SCIENCE AND TECHNOLOGY. 4 HOURS. The response of public systems to the scientific and technological revolution; the governmental institutions being devised to administer science and technology in the public sector. Emphasis on technological problems caused by the emergence of new metropolitan communities.

327. PUBLIC OPINION AND POLITICAL COMMUNICATION. 4 HOURS. The nature of public opinion and political communication systems; patterns of opinion distribution and techniques for opinion measurement; forces shaping public opinion, with emphasis on the mass media; the impact of public opinion on public policy; comparison of political communication patterns in the United States with less developed and totalitarian nations. Prerequisite: 6 hours of advanced political science, sociology, or modern history.

328. PROPAGANDA AND THE LANGUAGE OF POLITICS. 4 HOURS. The nature of propaganda, political symbols, and the language of politics; the uses of political symbols and propaganda in the political processes of democratic and totalitarian societies; international propaganda and psychological warfare; methods and uses of propaganda analysis. Prerequisite: Two courses in advanced political science, sociology, or modern history.

331. ELECTORAL BEHAVIOR. 4 HOURS. Emphasizes two aspects of the study of electoral behavior: social, economic, and psychological theories developed specifically for, or adaptable to, the explanation of electoral behavior; introduction to inductive studies of voting behavior. Prerequisite: PolS. 130 or 230.

332. QUANTITATIVE STUDY OF INTERNATIONAL POLITICS. 4 HOURS. The usefulness of statistical reasoning in making inferences about international politics. Political decision making, political conflict and cooperation, and political development and change in terms of three basic levels of analysis: multinational organization, nations, and international relations. Prerequisites: PolS. 184 and consent of the instructor.

334. POLITICAL SOCIALIZATION. 4 HOURS. Introduction to the problems of how people learn about the polity; from whom they learn, under what circumstances, and with what consequences. Prerequisite: Three courses in political science, including at least one dealing with human political behavior.

336. FILM AS A RESEARCH TECHNOLOGY IN THE SOCIAL SCIENCES. 4 HOURS. The techniques and problems of film as a technology for generating, interpreting, and presenting data. Prerequisite: Consent of the instructor.

337. THE POLITICS OF ALIENATION. 4 HOURS. Conceptual, empirical, and normative analysis of alienation from polity, society, culture, and self. Focus on the political consequences of various forms of alienation, including radicalism, apathy, protest, revolution, renewal, and innovation. Empirical research is required. Prerequisite: PolS. 230.

341. POLITICAL CULTURE. 4 HOURS. Examination of attitudes, values, beliefs, and behavioral norms which characterize the political system in the United States and other countries. Special problems, such as the nature of national identity, indicators of political cohesion, or determinants of political stability and instability, may be emphasized. Prerequisite: PolS. 100 or 120 or 130 or 152. At least one 200-level course in comparative politics is recommended.

351.   CONSTITUTIONAL LAW. 4 HOURS. Constitutional provisions and principles as
       they have developed through Supreme Court interpretation; the amending
       process; federalism; commerce, taxing, and war powers; due process of law; the
       constitutional relations between the three major branches of government.
       Prerequisite: At least one introductory political science course.

353.   SEMINAR: PROBLEMS OF CONSTITUTIONAL LAW. 4 HOURS. Supervised
       individual study of selected problems arising in the interpretation of the United
       States Constitution. Prerequisites:Pol. 351 or 355 and consent of the instructor.

355.   THE CONSTITUTION AND CIVIL LIBERTIES. 4 HOURS. The nature and
       constitutional positions of freedom of religion, speech, press, and others; varying
       interpretations of these freedoms; difficulties encountered in protecting them;
       problems of discrimination against racial, religious, and other minorities.
       Prerequisite: PolS. 150 or 151.

356.   ADMINISTRATIVE LAW. 4 HOURS. Legal problems arising in the relationships
       between the citizen and the government official; administrative rule making and
       enforcement; judicial review of administrative actions. Prerequisite: Consent of
       the instructor.

361.   POLITICAL LEADERSHIP. 4 HOURS. Examination of contemporary political
       leadership and elites. Various approaches to, and theories about, political
       leadership in a variety of situational contexts, such as small groups, developing
       nations, revolutionary societies, complex political systems and organizations.
       Prerequisites: PolS. 100, 120, 130 or 150 and PolS. 230.

362.   SEMINAR: PUBLIC ADMINISTRATION. 4 HOURS. Supervised individual study
       of selected problems. Prerequisite: PolS. 261 or 263.

364.   POLITICAL MODERNIZATION. 4 HOURS. The process of modernization in the
       United States and other countries; emphasis on the interaction between political
       and other factors, such as social change and economic growth; historical and
       contemporary patterns of political modernization and their problems.
       Prerequisites: PolS. 152 and one 200-level course in comparative politics.

370.   PRACTICUM IN TEACHING POLITICAL SCIENCE. 2 TO 8 HOURS. May be
       repeated for a maximum of 12 hours; no more than 6 hours may be applied
       toward the major in political science. Provides seniors and graduate students with
       a limited exposure to teaching political science by leading discussion sections of
       undergraduate courses at the same time that they participate in a seminar on the
       problems and methods of teaching in the field. Teaching assistants may not
       receive credit for this course unless they actually teach discussion sections and are
       enrolled in this seminar. Prerequisites: Senior or graduate student major in
       political science, at least a B average in political science courses, and consent of
       the instructor.

381.   SEMINAR: POLITICAL PROBLEMS OF DEVELOPING SOCIETIES. 4 HOURS.
       Same as Latin American Studies 381. Selected aspects of the politics of the
       countries of Asia, Africa, and Latin America. Prerequisite: PolS. 280.

385. WOMEN AND POLITICS: PROBLEMS IN POLICY ANALYSIS AND POLITICAL THEORY. 4 HOURS. The political, social, and economic participation of women in American society. Theories on the use of power, socialization, and psychobiology as models in analyzing the outputs and outcomes of policies that affect women. Prerequisite: 8 hours of political science at the 200 or 300 level. Political Science 230 is recommended.

386. PROBLEMS IN INTERNATIONAL ORGANIZATION. 4 HOURS. May be repeated once for credit. Subject matter varies from quarter to quarter, but centers upon one group of related problems pertaining to the United Nations or other international organizations. Prerequisite: Two courses in international politics or international organization. Political Science 184 and 286 are recommended.

388. SEMINAR: PROBLEMS IN AMERICAN FOREIGN RELATIONS. 4 HOURS. Supervised individual study of selected problems of contemporary United States foreign relations. Prerequisite: PolS. 281 or 184.

390. SCOPE AND METHODS OF POLITICAL SCIENCE. 4 HOURS. Examination of the scope and subject matter of political science. Special attention to analytic processes in the development of concepts, hypotheses, and theories. Methodologies and modes of analysis now in use by political scientists. Prerequisites: PolS. 100, 120, or 151 and one 200-level course in political science.

391. POLITICAL POWER. 4 HOURS. Examination of the problem of the nature of political power. Introduction to some of the major literature of power, and the development of the concept of political power as a descriptive category adequate to the comparative analysis of broader political phenomena, such as parties, official decision-making structures, and movements. Prerequisites: PolS. 120 or 150 and 4 hours of upper-division political science courses.

392. DEMOCRATIC THEORY. 4 HOURS. Democracy as a procedure of government and the value commitments associated with this form of government. Special attention is given to corporate wealth, special interests, bureaucracy, and the mass media as they effect the existence of democratic government.

395. POLITICAL VIOLENCE. 4 HOURS. Seminar. Analysis of the use, or threat, of violence in the political process. Attention is focused on domestic forms of violence and aggression in various nations viewed cross-culturally. Prerequisites: PolS. 150 or 151, two 4 hour courses in the social sciences, and consent of the instructor.

398. THE PROBLEM OF JUSTICE. 4 HOURS. Same as Criminal Justice 398 and Religious Studies 398. The premodern understanding of justice, Plato's or Aristotle's; the modern understanding of justice, such as Hobbes' or Locke's, which is the foundation of the modern political regime; Rousseau's seminal political thought on justice, which is the basis of a variety of reforms and alternatives offered to Hobbes' and/or Locke's political regime. Prerequisite: Two courses in political science, including PolS. 150 or 151.

399. SEMINAR IN POLITICAL THEORY. 4 HOURS. May be repeated for a total of 8
      hours. In-depth analysis and discussion of selected problems or works in political
      theory. Prerequisites: PolS. 290, 291, and 292.

Courses for Graduate Students

400. POWER IN URBAN AREAS: AN INTRODUCTION TO POLITICAL
      RESEARCH. 8 HOURS. Aspects of political analysis, including concept
      formation, explanation, and choice of research methods, applied to community
      power and other topics in urban politics. Emphasis on the ways in which urban
      politics and policies can be studied.

401. EXPERIENCING AND INTERPRETING POLITICS: THE USE OF
      LANGUAGE. 4 HOURS. Principles of concept formation in social science.
      Analysis of political words through ordinary language philosophy. Criteria of
    • meaning, including the verification principle and logical positivism. The function
      of language in the study of politics. Prerequisite: PolS. 400.

402. EXPERIENCING AND INTERPRETING POLITICS: THE USE OF LOGIC. 4
      HOURS. Theorizing: inductive and deductive. Logics of discovery and
      verification. Research designs. Measurement principles; data generation. Selection
      of objects and subjects; sampling. Data reduction. Prerequisite: PolS. 400.

403. EXPERIENCING AND INTERPRETING POLITICS: THE USES OF DATA. 4
      HOURS. Data analysis; descriptive statistics, display correlation and regression;
      inductive statistics; interpretation. Evaluation of data for inference is basic to the
      course. Prerequisite: PolS. 400. Political Science 402 is recommended.

408. GOVERNMENT AND POLITICS OF CHICAGO. 4 HOURS. The political process
      in Chicago, including an analysis of the city government and other governments,
      such as the Park and Sanitary districts. The role of the political parties, business
      and civic leaders, the press, and other factors involved in the governmental
      process. Prerequisite: PolS. 205.

409. SUBURBAN GOVERNMENT AND POLITICS. 4 HOURS. Examination of
      government and politics in suburban America. Particular attention is given to
      party structure, financing of governmental units, and the patterns of political
      competition in the suburbs. Prerequisite: PolS. 205.

420. SPECIAL PROBLEMS IN URBAN GOVERNMENT. 4 HOURS. Intensive study
      of selected current problems. Maximum emphasis on providing the student with
      an opportunity to undertake and report on independent research. Prerequisite:
      PolS. 205.

421. URBAN MANAGEMENT PROCESSES. 4 HOURS. The political and
      administrative aspects of managing the urban environment. The course is designed
      to give the student a view of the specific tasks that face urban executives, such as
      mayors, city managers, and department heads. Prerequisite: PolS. 212 or 317.

422.   SEMINAR ON POLITICS AND ADMINISTRATION. 4 HOURS. The interplay between politics and administration. The manner in which politics shape and condition public administration and vice versa. Both theoretical materials and empirical case studies are examined. Prerequisite: PolS. 261.

423.   SPECIAL TOPICS IN PUBLIC ADMINISTRATION. 4 HOURS. Analysis of selected problems. Topics considered vary from year to year, depending upon the needs and interests of the students. Prerequisite: PolS. 261.

424.   PROBLEMS IN STATE GOVERNMENT. 4 HOURS. Case analysis and research in selected problems dealing with the structure, functions, and administrative processes of American state governments. Prerequisite: PolS. 317 or 362.

426.   SEMINAR ON LEGISLATION AND PUBLIC POLICY. 4 HOURS. Intensive study of the institutional and dynamic forces that affect public policy making in the United States. Emphasis on the separation of powers and the role of pressure groups, public opinion, and organizational bureaucracies as they affect the decision-making process. Prerequisite: PolS. 315 or 316.

462.   TOPICS IN POLITICAL COMMUNICATION. 4 HOURS. May be repeated for credit up to a maximum of 12 hours. Intensive study of selected aspects of political communication, such as urban political communications patterns, communication elites, mass media influence on electoral politics, and mass media influence on political images. Emphasis on independent research, using a variety of communication research techniques. Prerequisite: Consent of the instructor.

464.   TOPICS IN POLITICAL MODERNIZATION. 4 HOURS. The process of political modernization in various contexts, such as urban, community-group, state, national, American, and/or foreign, from such perspectives as structural-functional, historical, dynamic-processual. Implications for political ideas, structures, and behavior. Prerequisite: PolS. 364.

481.   EVALUATION OF POLICY OUTCOMES. 4 HOURS. The procedures by which social science researchers investigate the impact of public policy on realization of objectives. The development of a measurement rationale for analyzing policy impact and the methodologies utilized in conducting the evaluation. Prerequisite: PolS. 400.

482.   PROBLEMS IN AMERICAN CONSTITUTIONAL LAW. 4 HOURS. Research in selected problems evolving from conflicting interpretations of the United States Constitution. Prerequisite: PolS. 351 or 355 or the equivalent.

484.   TOPICS IN PUBLIC POLICY ANALYSIS. 4 HOURS. A research seminar focusing on the student's development and execution of a research design for the analysis of a particular policy area. Prerequisite: PolS. 481.

485.   SEMINAR ON ADMINISTRATIVE THEORY AND BEHAVIOR. 4 HOURS. Analysis of the theory of bureaucratic organization in several substantive areas. The nature and function of theory in administrative study; basic concepts, hypotheses, and research findings in organizational theory and behavior;

leadership theory, decision-making; organizational authority; patterns of accommodation between the organization and its members. Prerequisite: PolS. 261.

486. SEMINAR: COMPARATIVE AND INTERNATIONAL ADMINISTRATION. 4 HOURS. Supervised individual study of selected problems. Prerequisite: PolS. 263.

497. DIRECTED READINGS IN POLITICAL SCIENCE. 4 HOURS. May be repeated for a maximum of 8 hours. Intensive readings on a topic not covered in the regular curriculum. Prerequisite: Consent of the instructor.

498. INDEPENDENT RESEARCH IN POLITICAL SCIENCE. 2 TO 8 HOURS. May be repeated for a maximum of 8 hours. Research on special problems not included in the regular course offerings. The work undertaken for this course may not duplicate that being done for Political Science 499. Prerequisite: Consent of the instructor.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Open only to degree candidates. Individual study and research required of all students pursuing the advanced degree in political science under the thesis option.

PSYCHOLOGY

Professors: Leonard D. Eron, Chairman of the Department; Philip Ash, Gershon B. Berkson, Rosalind D. Cartwright, John D. Davis, Roger L. Dominowski, Isadore E. Farber, Benjamin Kleinmuntz, Susan M. Markle, Sheldon Rosenberg, Harry S. Upshaw

Associate Professors: Philip E. Freedman, Associate Chairman of the Department, Jerry Adams, Charles L. Gruder, Executive Sercretary; Ernest W. Kent, Leon K. Miller, Rolf Peterson, Alexander J. Rosen, Gerald Senf, Herbert H. Stenson, Judith V. Torney

Assistant Professors: Raymond Bennett, Alan Benton, Leonard P. Kroeker, Michael Levine, Leonard W. Sushinsky

Lecturers: Joan M. Wallace

The department offers work leading to the Master of Arts and the Doctor of Philosophy.

Admission Requirements

Minimum departmental requirements are as follows:
    A. A grade-point average of 4.20 (A=5.00) for both the last two years of

undergraduate study and for all graduate work. A student whose average is between 4.20 and 4.00 may be considered on the basis of individual merit.

B. The equivalent of 24 quarter hours in psychology, including statistics and a laboratory course in experimental psychology, one year of college mathematics, and one year of laboratory courses in physical and/or biological sciences. Students with exceptionally high grade-point averages and/or scores on the Graduate Record Examination who do not fulfill all course requirements may be admitted provisionally, pending satisfactory completion of the course requirements without graduate credit.

C. Satisfactory scores on the Graduate Record Examination aptitude tests (verbal and quantitative) and the advanced test in psychology. Standards of acceptable performance on the advanced test may be modified for undergraduate majors in fields other than psychology if they are otherwise especially well qualified.

D. Satisfactory ratings by three faculty members, preferably psychologists, who are familiar with the applicant's training and ability. In the case of candidates who have been engaged in professional work for some years, ratings by supervisors may be substituted.

Graduate admissions are limited; therefore, it may not be possible to accept all applicants who meet the foregoing minimum requirements. Preference will be given to candidates particularly well qualified in quantitative and experimental psychology and in the natural sciences.

Special consideration is given in admissions and in academic program planning to students who are judged especially likely to succeed even though they do not meet the admissions criteria. Minority-group members who may have experienced educational disadvantage are encouraged to apply under this provision.

Although applications may be accepted until the Graduate College deadline, students who expect to enter the department's program in the fall are advised to complete their applications by March 1. Completed application materials must include applications for admission and for graduate appointment, referees' ratings, official transcripts, and Graduate Record Examination scores.

Degree Requirements

The department offers work leading to the Master of Arts and the Doctor of Philosophy. The faculty of the department is organized into an undergraduate division, and nine graduate divisions, corresponding to substantive and curricular interests. Six of the divisions correspond to broad, substantive areas: cognitive psychology, developmental psychology, learning-motivation, methodology and measurement, physiological psychology, and

social psychology. Three of the divisions cover the graduate curriculum of the department: the academic curriculum, the clinical curriculum, and the organizational curriculum. Within these, specialties are available in industrial psychology, institutions of higher education, and school psychology. Course requirements have been established for each division. Students elect one substantive and one curricular division, which usually determine the program of study.

Master of Arts

A candidate must complete 48 quarter hours of graduate-level course work (including research) and present an acceptable thesis. At least 16 quarter hours must be in one of the six substantive divisions. This program will be established by the division. The candidate must also complete Psychology 343.

Doctor of Philosophy

A candidate must complete 144 quarter hours of graduate-level course work (including research). In addition, he must have completed a master's thesis or its equivalent and must pass preliminary examinations, demonstrate proficiency in special research skills, and present an acceptable dissertation. Courses offered in fulfillment of these requirements must include Psychology 343, 370, 443, 444, and the programs of one of the substantive divisions and one of the three curriculum divisions. The candidate must also complete at least two courses in each of two cognate areas. These courses and areas will be specified by the substantive division.

By virtue of its urban setting and its proximity to a large number of academic, health, and community institutions, the department has training and research facilities throughout the Chicago area. Among them are the University of Illinois Medical School, the Neuropsychiatric Institute, the Institute of Juvenile Research, the Chicago and suburban public schools, the Cook County Sheriff's Office Court Services training facilities, and the Chicago Association for the Retarded.

Courses for Graduate and Advanced Undergraduate Students

312.   PERSON PERCEPTION. 4 HOURS. Analysis of theory and research on the perception and evaluation of persons in social settings, with emphasis on role theory, attribution, and social comparison processes. Applications to dynamics of interpersonal attraction, affiliation and influence in experimental and natural settings. Prerequisite: Graduate standing or Psch. 265 and consent of the instructor.

313. SOCIAL JUDGMENT. 4 HOURS. Analysis of the judgment process and its implications for social psychological phenomena. Prerequisite: Graduate standing or Psch. 265 and consent of the instructor.

314. ATTITUDE CHANGE. 4 HOURS. Critical analysis of selected contemporary theory and research. Topics include source and message effects, determinants of persistence of change and resistance to change. Prerequisite: Graduate standing or Psch. 265 and consent of the instructor.

315. COGNITIVE CONSISTENCY PROCESSES. 4 HOURS. Critical analysis of research and theory related to the processes of information integration and its implications for attitude and opinion change. Emphasis on cognitive consistency formulations and their derivatives. Prerequisite: Graduate standing or Psch. 265 and consent of the instructor.

316. ANIMAL BEHAVIOR. 4 HOURS. Principles and methods in the study of animal behavior; review of the social behavior of representative species in various phyla. Prerequisites: BioS. 100, 101, 102, and Psch. 143.

323. PSYCHOLOGY OF THE EXCEPTIONAL CHILD. 4 HOURS. Methods, results, and interpretation of studies of physically, intellectually, and emotionally deviant children, with special reference to their implications for education and behavior modification. Prerequisite: 12 hours of psychology including Psch. 220 or the equivalent.

330. ORGANIZATIONAL PSYCHOLOGY. 4 HOURS. Same as Management 330. Individual psychological and group processes and their interaction with organizational structure. Behavioral factors in effective organizational change. Prerequisite: Graduate standing or Psch. 243, one course in social psychology or industrial psychology, and consent of the instructor.

332. PERSONNEL PSYCHOLOGY. 4 HOURS. Systematic study of the development and utilization of psychological techniques of personnel selection, classification, and assessment. Prerequisite: Graduate standing or Psch. 240, 243, and consent of the instructor.

333. MOTIVATION AND MORALE IN ORGANIZATIONS. 4 HOURS. Same as Management 333. Concepts and methods in the assessment and modification of motivation, attitudes, and morale. Prerequisite: Graduate standing or 12 hours of psychology, including Psch. 330, and consent of the instructor.

335. PSYCHOLOGY OF INDUSTRIAL TRAINING. 4 HOURS. Same as Management 335. Psychological measurement techniques in assessing training needs and evaluating training effectiveness. Application of psychological techniques to the development of industrial training programs. Prerequisite: Graduate standing or Psch. 332 or the equivalent.

338. PSYCHOLOGY OF INDUSTRIAL CONFLICT. 4 HOURS. Same as Management 338. Behavioral analysis of the causes, dimensions, and modes of resolution of

industrial conflict; special emphasis on labor-management relations. Prerequisite: Graduate standing or Psch. 330 or the equivalent.

343. ADVANCED STATISTICS I. 4 HOURS. Elementary probability theory, empirical and theoretical distributions, points and interval estimation, hypotheses testing. Prerequisite: Graduate standing or Psch. 243 and consent of the instructor.

345. PSYCHOMETRIC APPLICATIONS. 4 HOURS. Theory of psychological tests and measurement applied to problems of ability and personality testing; opinion sampling; reliability and validity; prediction and selection processes. Prerequisite: Graduate standing or Psch. 243 and consent of the instructor.

350. LEARNING AND CONDITIONING. 4 HOURS. Methods, results, and interpretation of experimental studies of basic learning processes in animal and human subjects. Prerequisite: Graduate standing or Psch. 261 and consent of the instructor.

351. PROGRAMMED LEARNING. 4 HOURS. Theory and research in the techniques, applications, and results of programmed instruction. Prerequisite: Graduate standing or Psch. 224 and consent of the instructor.

352. MOTIVATION. 4 HOURS. Methods, results, and interpretation of experimental studies of basic motivational processes in animal and human subjects. Prerequisite: Graduate standing or Psch. 261 or 266 and consent of the instructor.

353. OPERANT CONDITIONING. 4 HOURS. Survey of basic principles and current research in the area of operant behavior. Prerequisite: Graduate standing or consent of the instructor.

354. THE PSYCHOLOGY OF LANGUAGE. 4 HOURS. Same as Linguistics 374 and Speech and Theater 354. Introductory survey of methods, theory, and research; acquaints students with the history and present status of psychology's interest in language behavior. Prerequisite: Consent of the instructor.

355. HIGHER PROCESSES. 4 HOURS. Methods, results, and interpretations of experimental studies of language behavior, problem solving, concept formation, and creativity. Prerequisite: Graduate standing or consent of the instructor.

356. SENSORY AND PERCEPTUAL PROCESSES I. 4 HOURS. Methods, results, and interpretation of experimental studies dealing with the determination of psycho-physical functions. Primary emphasis on the perception of single discrete stimuli and attributes of stimuli. Prerequisite: Graduate standing or Psch. 250 and consent of the instructor.

357. SENSORY AND PERCEPTUAL PROCESSES II. 4 HOURS. Methods, results, and interpretation of experimental studies dealing primarily with the role of contextual and experimental factors in perception. Prerequisite: Graduate standing or Psch. 250 and consent of the instructor.

360. HUMAN FACTORS. 4 HOURS. Application of experimentally derived principles of behavior to the design of equipment for efficient use and operation. Sensory and perceptual processes, motor skills, and experimental methodology. Prerequisite: Graduate standing or 12 hours of psychology, including Psch. 250 and 251 or the equivalents.

361. INSTRUMENTATION IN PSYCHOLOGY. 4 HOURS. Use of transducers, programming equipment, and recording systems in psychological research. Prerequisite: Graduate standing or consent of the instructor.

362. PHYSIOLOGICAL PSYCHOLOGY. 4 HOURS. Methods, results, and interpretation of experimental studies of physiological and neurochemical correlates of learning, motivation, and perception. Laboratory demonstrations and problems. Prerequisites: Graduate standing or 12 hours of psychology, including Psch. 256. or the equivalent, and consent of the instructor.

363. BEHAVIORAL PHARMACOLOGY. 4 HOURS. Methods, results, and interpretation of experimental studies dealing with drugs and behavior. Emphasis on elucidating the role of drugs as tools in behavioral research and on the use of experimental psychology techniques to explicate drug action. Prerequisite: Graduate standing or Psch. 251, 256, and consent of the instructor.

370. SYSTEMS AND THEORIES. 4 HOURS. Critical introductory analysis of major historical systems and their representation in current theoretical issues. Prerequisite: Graduate standing or Psch. 250, 251, and consent of the instructor.

382. INTRODUCTION TO CLINICAL PSYCHOLOGY. 4 HOURS. The major areas, including assessment, treatment, and consultation, are considered in terms of current theory, practice, and research. Practicum work in a clinical endeavor, such as intellectual appraisal of children or organizational diagnosis of an elementary school, supplements classroom activity. Prerequisites: Psch. 243 or 240 and consent of the instructor.

399. PROBLEMS IN PSYCHOLOGY. 2 TO 12 HOURS. May be repeated for a total of 12 hours. Investigation of special problems under the direction of a staff member. Prerequisites: Consent of the instructor and approval of the head of the department.

Courses for Graduate Students

Note: The prerequisites stated apply to graduate majors in psychology. Students minoring in psychology or majoring in related fields may, with the consent of the instructor, enroll in certain courses without having met all prerequisites.

400. MEMORY. 4 HOURS. Comparison of theoretical formulations and evaluation of research findings on human learning and retention.

401. EXPERIMENTAL PSYCHOLINGUISTICS. 4 HOURS. Same as Linguistics 471 and Speech and Theater 401. Intensive review of experimental laboratory studies

concerned with the effects of phonological, syntactic, and semantic variables on sentence perception, comprehension, production, and memory in the mature user of language. The relevance of the research in contemporary psycholinguistic theory is emphasized. Prerequisites: Psch. 354 or the equivalent and consent of the instructor.

408.   INSTRUCTIONAL PSYCHOLOGY. 4 HOURS. Psychological analysis of complex subject matter and the process of instruction; emphasis on the acquisition of structured knowledge.

409.   SEMINAR IN COGNITIVE PSYCHOLOGY. 4 HOURS. May be repeated. Systematic review of special topics; emphasis on current research and theoretical developments. Prerequisite: Consent of the instructor.

410.   EXPERIMENTAL APPROACHES TO PERSONALITY. 4 HOURS. Analysis of empirical and theoretical advances in experimental factors in learning, motivation, and cognition with individual differences variables. Prerequisite: Consent of the instructor.

411.   SMALL GROUPS: STRUCTURE AND PROCESS. 4 HOURS. Same as Sociology 411. Systematic survey of research and theory dealing with social interaction and social relationships in small groups; primary groups as agents of social influence and social control. Prerequisite: Consent of the instructor.

412.   RESEARCH METHODS IN SOCIAL PSYCHOLOGY. 4 HOURS. Principles of design, data collection, and analysis of social psychological research in the laboratory and in naturalistic settings. Prerequisite: Psch. 444.

416.   THEORIES OF SOCIAL BEHAVIOR. 4 HOURS. Current theoretical formulations and relevant data concerning major aspects of social behavior. Prerequisite: Psch. 310 or the equivalent.

419.   SEMINAR IN SOCIAL PSYCHOLOGY. 2 HOURS. May be repeated for credit. Critical discussion of selected topics, such as social judgment, group processes, attitude formation and change. Content will vary. Prerequisites: Relevant 300-level or 400-level courses in social psychology and consent of the instructor.

420.   ADVANCED DEVELOPMENTAL PSYCHOLOGY. 4 HOURS. Theory and research on psychological development through adolescence; physical, mental, and social growth. Prerequisites: Psch. 220 or the equivalent and consent of the instructor.

421.   DEVELOPMENTAL PSYCHOBIOLOGY. 4 HOURS. Review of theories of behavioral development from a biological orientation. Prerequisites: Psch. 420 and consent of the instructor.

422.   COGNITIVE DEVELOPMENT. 4 HOURS. A review of contemporary theory and research dealing with intellectual development from birth to young adulthood. Prerequisite: Psch. 420.

423. PERCEPTUAL DEVELOPMENT. 4 HOURS. Examination of contemporary theory and research dealing with the assessment and development of perceptual capacities in children. Prerequisites: Psch. 357 and 420.

424. SOCIAL DEVELOPMENT. 4 HOURS. Discussion at an advanced level of processes and substantive areas of social development; major stress on social learning theory, socialization, dependency, identification, and cognitive-developmental processes as they influence social development. Participation in a small research or interview project is required. Prerequisite: Psch. 420.

425. PRACTICUM IN DEVELOPMENTAL PSYCHOLOGY. 2 HOURS. May be repeated. Supervised practice in the observation and assessment of behavior development in natural settings, including preschool, grade school, and special treatment units. Normal and exceptional children and adolescents. Prerequisites: Psch. 420 or the equivalent and consent of the instructor.

427. DEVELOPMENTAL PSYCHOLINGUISTICS. 4 HOURS. Same as Linguistics 472. Theoretical formulation, research methods, and research findings in the areas of language development. Biological foundations and environmental influences; disorders of language development. Prerequisites: Psch. 354 or the equivalent and consent of the instructor.

429. SEMINAR ON DEVELOPMENTAL PSYCHOLOGY. 2 HOURS. May be repeated. Systematic review of special topics; emphasis on current research. Prerequisites: Psch. 420 or the equivalent and consent of the instructor.

430. CONTEMPORARY THEORIES OF PSYCHOTHERAPY. 4 HOURS. Basic principles, practices, and theories of counseling. Prerequisite: Consent of the instructor.

434. PRACTICUM IN ORGANIZATIONAL PSYCHOLOGY. 2 TO 4 HOURS. May be repeated. Supervised practicum in organizational settings, including industry and educational institutions. Prerequisite: Psch. 330.

435. PRACTICUM IN PSYCHOTHERAPY. 4 HOURS. May be repeated for credit for a maximum of 8 hours. Supervised practice in a counseling or clinical setting. Application of basic principles; special emphasis on the problems of the culturally disadvantaged. Prerequisites: Psch. 430 and consent of the instructor.

436. PERSONNEL MEASUREMENT TECHNIQUES IN INDUSTRY. 4 HOURS. Development, analysis, and use of tests in the selection, classification, and performance evaluation of industrial personnel. Practice in the development and validation of industrial classification and selection of test batteries are included. Prerequisites: Psch. 332 or the equivalent and Psch. 345.

438. SEMINAR ON ORGANIZATIONAL PSYCHOLOGY. 4 HOURS. May be repeated. Review of current topics, which are announced each quarter. Prerequisite: Consent of the instructor.

439. RESEARCH IN COUNSELING AND PSYCHOTHERAPY. 4 HOURS. Systematic review of special topics on individual treatment; emphasis on current research. Prerequisites: Psch. 430 and consent of the instructor.

443. ADVANCED STATISTICS II. 4 HOURS. The Chi-square and F-distributions, analysis of variance, individual comparisons, regression, and correlation analysis. Prerequisite: Psch. 343 or the equivalent.

444. EXPERIMENTAL DESIGN AND ANALYSIS OF VARIANCE. 4 HOURS. Analysis of variance and testing of hypotheses concerning contrasts in means in advanced experimental designs used in behavioral research. Prerequisite: Psch. 443 or the equivalent.

445. MULTIVARIATE ANALYSIS. 4 HOURS. The statistical analysis of functional relationships among two or more variables; various forms of correlation analysis; introduction to discriminant and factor analysis. Prerequisite: Psch. 443 or the equivalent.

446. RESEARCH METHODS IN NATURALISTIC SETTINGS. 2 HOURS. Problems associated with the collection and analysis of data in naturalistic settings, emphasizing unobtrusive measures and the logic of causal emphasis based on correlational procedures and quasi-experimental designs.

447. PSYCHOLOGICAL MEASUREMENT. 4 HOURS. Scaling theory and methodology; emphasis on measurement in psychophysics, differential psychology, and social psychology. Prerequisites: Psch. 343 and 315 or 356 or the equivalents.

448. TOPICS IN QUANTITATIVE PSYCHOLOGY. 4 HOURS. May be repeated for credit. Seminar devoted to a preannounced topic in methodology, measurement, or mathematical psychology. Prerequisite: Consent of the instructor.

449. SEMINAR ON QUANTITATIVE METHODS IN PSYCHOLOGY. 2 HOURS. May be repeated. Systematic review of special topics; emphasis on current developments and applications. Prerequisite: Consent of the instructor.

450. TOPICS IN PHYSIOLOGICAL PSYCHOLOGY. 2 TO 4 HOURS. May be repeated. Methods, results, and interpretations of experiments concerned with the neuroanatomical, neurophysiological, and neuropharmacological bases of learning, emotion, and perception. Prerequisites: Psch. 362, 363.

451. TECHNIQUES OF PSYCHOLOGICAL INTERVENTION. 4 HOURS. May be repeated if instructor consents. Critical analysis of principles, techniques, and research in various types of psychological intervention. Each quarter the focus is on a different technique, such as behavior modification, psychotherapy, group therapy, play therapy, and community consultation. Prerequisite: Psch. 430.

452. PHYSIOLOGICAL BASES OF EMOTION. 4 HOURS. Methods, results, and interpretations of experiments with the neuroanatomical, neurophysiological, neuropharmacological, and neuroendocrinological substrates of emotional behavior. Prerequisites: Psych. 362, 363.

453. PHYSIOLOGICAL BASES OF LEARNING AND MEMORY. 4 HOURS. Methods, results, and interpretations of experiments with the neuroanatomical,

neurophysiological, and neuropharmacological substrates of conditioned behavior. Prerequisites: Psch. 350, 362, and 363.

455. PHYSIOLOGICAL BASES OF PERCEPTION. 4 HOURS. An advanced course. The neurophysiology of sensory and perceptual processes; physiology of peripheral receptor systems and data processing in central mechanisms. Prerequisite: Psch. 362.

456. DISCRIMINATION LEARNING. 4 HOURS. Generalization, simultaneous and successive discrimination, secondary reinforcement, and choice behavior are studied with respect to various theoretical predictions. Oral presentations on related topics are required. Prerequisite: Psch. 350.

461. ADVANCED INSTRUMENTATION IN PSYCHOLOGY. 4 HOURS. Design of electronic instrumentation in psychological research. Alternate years concentrate on linear (amplification) or digital (logic) devices. Prerequisite: Psch. 361.

470. THEORIES OF LEARNING. 4 HOURS. Historical and methodological analysis of theoretical formulations of learning. Prerequisite: Psch. 350.

472. THEORIES OF PERSONALITY. 4 HOURS. Contemporary theoretical formulations concerning personality and their evidential basis. Prerequisite: Psch. 350 or 352.

473. ADVANCED PSYCHOPATHOLOGY. 4 HOURS. A basic course for all graduate students in clinical psychology, a core course. Detailed consideration of disorders of behavior, including description, etiology, prognosis, and experimental and clinical research; development and function of classification systems. Prerequisite: Psch. 472.

474. CLINICAL NEUROPSYCHOLOGY. 4 HOURS. Investigation of the current status of work in clinical neuropsychology; focus on the behavioral consequences of cerebral dysfunction and on the efforts to synthesize information on these consequences into a cohesive and systematic understanding of the basic brain-behavior relationship in man. Prerequisite: Psch. 473.

479. SEMINAR: THEORETICAL, HISTORICAL, AND PHILOSOPHICAL ISSUES IN PSYCHOLOGY. 2 HOURS. May be repeated. Same as History 479 and Philosophy 479. Systematic review of special topics; emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.

480. BEHAVIOR DISORDERS IN CHILDREN. 4 HOURS. Major types of maladjustment in childhood. Emphasis on the emotional, motivational, and intellectual difficulties of the culturally deprived. Prerequisite: Consent of the instructor.

482. PSYCHOLOGICAL APPRAISAL I: TEST DEVELOPMENT, INTELLECTUAL FUNCTIONS. 4 HOURS. Theory of test development and test assessment. Theory, research, and techniques relating to the assessment of intellectual abilities. Training in the administration, scoring, and interpretation of standard test methods.

483. PSYCHOLOGICAL APPRAISAL II: INTELLECTUAL FUNCTIONS AND STRUCTURED TESTS. 4 HOURS. Intelligence tests in clinical use. Theory and research relating to the development and use of structured tests for personality assessment. Training in the administration, scoring, and interpretation of structured tests. Prerequisite: Psch. 482 or the equivalent.

484. PSYCHOLOGICAL APPRAISAL III: PROJECTIVE TECHNIQUES. 4 HOURS. Theory and research relating to the development and use of projective techniques for personality assessment. Training in the administration, scoring, and interpretation of projective techniques. Prerequisite: Psch. 483 or the equivalent.

485. PRACTICUM IN PSYCHOLOGICAL APPRAISAL. 4 HOURS. May be repeated. Supervised practice in psychodiagnostic testing in various facilities associated with the graduate training program in clinical and counseling psychology. Prerequisites: Concurrent registration in Psch. 482 or 484 and consent of the instructor.

487. PRACTICUM IN INSTRUCTION IN PSYCHOLOGY. 8 TO 12 HOURS. Supervised teaching of an undergraduate course and participation in a seminar dealing with techniques of course planning, teaching, and examining. Prerequisite: 6 hours of credit in Psch. 490.

488. SEMINAR ON CLINICAL PSYCHOLOGY. 2 HOURS. Selected topics. Prerequisite: Consent of the instructor.

489. SEMINAR ON ADVANCED PSYCHODIAGNOSTICS. 4 HOURS. Consideration of a series of children and adolescents with varied behavior and school problems who have been studied intensively with psychodiagnostic procedures and for whom extensive follow-up data are available. Appropriate readings; clinical report writing. Prerequisites: Psch. 484, 485, and consent of the instructor.

490. COLLOQUIUM ON THE TEACHING OF PSYCHOLOGY. 2 HOURS. May be repeated for a total of 6 hours. Satisfactory/unsatisfactory grade only. Problems and methods of teaching at the college level. Group discussion techniques; task analysis; test construction and analysis; curricular materials. Prerequisite: Graduate standing in the department.

491. COLLOQUIUM ON RESEARCH IN PSYCHOLOGY. 2 HOURS. May be repeated for a total of 6 hours. Satisfactory/unsatisfactory grade only. Discussion and evaluation of individual research projects; directed training in conducting research in different areas of psychology and in developing skills related to this research.

495. INDIVIDUAL RESEARCH. 2 TO 8 HOURS. May be repeated. Satisfactory/ unsatisfactory grade only. Research on special problems not included in the graduate thesis. Prerequisite: Consent of the instructor.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Research on the topic of the graduate thesis. Prerequisites: Consent of the instructor; approval of the research prospectus by the thesis committee.

SOCIAL WORK

Professors: Mark P. Hale, Director; George W. Magner, Associate Director; W. Paul Simon, Mary Sullivan, Imogene Young, Samuel Weingarten, Sidney Zimbalist

Associate Professors: Claire M. Anderson, Eloise J. Cornelius, H. Frederick Brown, Frieda Engel, James Forkeotes, Joseph R. Godwin, Joy Johnson, Kenneth Krause, Edwin Marksman, Ord Matek, Harvey Treger, Joan Wallace, Narayan Viswanathan

Assistant Professors: Leona B. Cain, Leonora Cartright, John C. Dietmann, Almera Lewis, Clarence Lipschutz, Ruth Meyer, Rhoda Michaels, Seymour Mirelowitz, Christopher G. Narcisse, Jeanore Parham, Sylvia Vedalakis, Dorothy R. Young

Instructors: James Collier, James Cousins, Rae Freed, Patricia Quinn

The Jane Addams Graduate School of Social Work offers, on both the Chicago Circle and the Urbana campuses, programs of professional study that lead to the Master of Social Work and the Doctor of Social Work.

Master of Social Work

The MSW program of the Jane Addams School is designed to give the student the knowledge, skills, attitudes, and philosophy basic to all professional social work practice rather than merely to prepare him for positions in specific agencies. Within each of the concentrations there are organized curriculum areas that include human growth and behavior, social work practice, welfare policy and services, and social research. At Chicago Circle most of the second year offerings are electives, which allow the student to pursue individual career interests. In both years an extensive field, or direct practice, experience is required.

In Chicago, field work is generally concurrent with class work, although several alternate models are being tested. The student will usually be placed in two distinct settings, with attention being paid to career interests and desired method of practice (such as casework, group work, community organization). There are a few instances where deference is given an agency from which a student holds a scholarship.

Much of the first-year program of the Jane Addams Graduate School of Social Work at Chicago Circle is mandatory and is comprised of those courses considered generic to all aspects of social work practice. Students who enter the School with a strong undergraduate social welfare background may, upon satisfactorily demonstrating the necessary knowledge base, have some of

these requirements waived. These first-year courses generally include a social work method or a combination of methods, welfare policy and services, an overview of community organization practice, social work research, human growth and behavior (with a dual focus on ego psychology and social science theory), and field instruction. In the second year there is a great deal of flexibility, and a number of electives and alternatives are available in all of the major concentrations, social treatment, community organization and planning, and social welfare policy.

Admission Requirements for the Master of Social Work

A satisfactory undergraduate scholastic record, 20 hours in the social sciences, and evidence of personal suitability for the field are the basic requirements. The minimum undergraduate grade-point average is 3.75 (A=5.00), and only under unusual circumstances is consideration given to an applicant with a grade-point average below 3.75.

Since the number of possible enrollments is limited and new students will be admitted only in the fall quarter, early application is advisable. Scholarships and fellowships are available through the School and through many public and private social agencies.

A bulletin about the School and application forms may be obtained by writing the Jane Addams Graduate School of Social Work at Chicago Circle, Box 4348, Chicago, Illinois 60680. A listing of agencies and field instructors is included in the School bulletin.

The Joint Program with McCormick Theological Seminary

A special curriculum has been arranged in cooperation with the McCormick Theological Seminary in Chicago through which students may simultaneously complete requirements for the Master of Social Work (casework or group work) and the Bachelor of Divinity or the Master of Arts in Christian Education or the Master of Arts in Church and Community.

This program is for a limited number of students who plan to engage specifically in social services under religious auspices. It usually requires three years of graduate study at the Seminary and at the School of Social Work. Financial assistance is available. Applicants must be accepted by both institutions and must apply to both. Seminary applicants should address: Department of Church and Community, McCormick Theological Seminary, 2330 North Halsted Street, Chicago, Illinois 60614.

Degree Requirements for the Master of Social Work

Hours: Candidates must successfully complete 96 quarter hours of graduate work (including work in each of the four general areas) with a

cumulative grade-point average of 4.00, which is required if a candidate is to remain in good standing. Those whose average falls below 4.00 in any quarter will be placed on probation and will be required to achieve a 4.00 minimum cumulative average by the end of the year.

Residence: A minimum of 36 quarter hours of resident credit is required; the candidate must carry a full program (12 quarter hours) at Chicago Circle for at least three consecutive quarters. A maximum of 48 hours of credit may be transferred for work taken elsewhere.

Time Limit: All requirements must be completed within six years. Military service is deducted. Exceptions may be made only in unusual circumstances. Several plans have been developed for spreading the degree program over a three-year period with one year devoted to full-time work in residence.

Courses for Graduate Students

Prospective students should note that the curriculum of the School of Social Work is undergoing extensive modification. Therefore, the following courses reflect only a portion of the total that are being developed. For example, in addition to the social treatment courses listed, there are a number of other electives: clinical diagnosis, crisis intervention, treatment with children, advanced group dynamics, treatment with adolescents, and others. In the foundation courses within the human growth and behavior area are such electives as: human sexuality, drug abuse, majority and minority cultural interaction, the black experience, theories of personality, and theories of psychotherapy. There will also be available in the 1973-1974 academic year a number of courses within the newer concentrations—community organization and planning and social welfare policy and administration. Because many of these are still being processed they could not be included at the time of this printing.

The Doctor of Social Work

The DSW program of the Jane Addams School is designed to increase the number of persons who have the knowledge and skills to develop and direct social welfare programs. It will provide preparation for leadership in teaching, research, policy analysis and development, and social welfare administration.

The doctoral program is interdisciplinary and strongly emphasizes research. The student is expected to choose an area of specialization, some examples of which are listed below:

Information Systems for Community Planning
Theories of Process in Social Treatment
Social Welfare Manpower Planning
Community Mental Health Planning
Social Policy for the Aged

An individualized plan of study will provide a wide range of possibilities, especially since a minor in a field outside social work is expected. The student is encouraged to select and develop a dissertation topic in the first two semesters of residence.

Admission Requirements for the Doctor of Social Work

The Doctor of Social Work program is open to students who have had advanced education in the human service professions or in related social sciences. Most entering students are expected to have an MSW, although this is not a requirement.

A B average is required for consideration, as are the Miller Analogies Test and the Graduate Record Examination. An Admissions Committee, composed of social work faculty from both the Chicago and the Urbana Divisions, will process all applications.

Degree Requirements for the Doctor of Social Work

The DSW will be awarded upon completion of the following requirements:

1. A minimum of 144 units of course work and applied research beyond the baccalaureate, of which at least 24 units will be in courses outside the School of Social Work.

2. A social work practicum or acceptable experience in lieu thereof.

3. A preliminary examination on substantive knowledge and a dissertation topic.

4. A dissertation based on original research or scholarly analysis of a professional problem or issue.

5. A final examination.

Since the Doctor of Social Work is a highly individualized program, interested persons should communicate with the Director of the DSW program at the School of Social Work for additional information.

Courses for Graduate and Advanced Undergraduate Students

305.   EDUCATION POLICY FOR CITIZENS. 4 HOURS. Same as Education 305. The concepts and information that all citizens need to participate effectively as education consumers and policy affectors. History, economics, basic statistics, sociology, research, and current and future trends affecting American education at all levels. Prerequisite: Consent of the instructor.

Courses for Graduate Students

400.   SOCIAL TREATMENT PRACTICE. 2 TO 4 HOURS. The basic concepts of social casework, social group work, and combined methods. Analysis and study of underlying philosophy, values, and principles. Skills used in working with groups, individuals, and families.

401.   SOCIAL CASEWORK I. 2 TO 4 HOURS. Analysis and study of the underlying philosophy, concepts, generic principles, and methods of social casework; role of the caseworker in offering service through a professional relationship.

402.   SOCIAL CASEWORK II. 2 TO 4 HOURS. Continues development of social casework concepts and principles through analysis of case material from secondary settings. Consideration of psychological and cultural factors which affect the treatment process. Analysis of the interconnectedness of relationship, study-diagnosis, and treatment phases of social casework. Prerequisite: SocW. 401.

403.   SOCIAL CASEWORK III. 2 TO 4 HOURS. Continues Social Work 402. Emphasis on increased independent analysis of case material and use of relevant source material related to specific cases. Learning experiences are arranged to assist the student to acquire greater integration of philosophy, concepts, and principles in social casework. Prerequisite: SocW. 402.

404.   SELECTED TREATMENT METHODS. 3 TO 6 HOURS. Intensive study of particular applications of social work practice. Theory base and skill development in the use of methods. Typical sections in family diagnosis and treatment, crisis intervention, advanced casework, and interrelated treatment models. Prerequisites: SocW. 403 or 414 or 423 and SocW. 442.

405.   FAMILY DIAGNOSIS AND TREATMENT. 3 HOURS. The evolution and definitions of family treatment; identification and examination of theories which add to the understanding of family diagnosis and treatment, application of selected theories and therapeutic methods to a variety of dysfunctional family situations. Use of family therapy in social work is stressed. Prerequisite: SocW. 403.

406.   SOCIAL CASEWORK VI. 2 TO 4 HOURS. Casework theory and practice focused on multiple-client interviewing and family diagnosis and treatment. Current issues in casework theory and the changing role of the caseworker in a changing society are discussed. Prerequisite: SocW. 405.

407.   CONSULTATION. 2 TO 4 HOURS. The knowledge and theory base of consultation; emphasis on the role of the social worker as a consultant. Examination of the several models of consultation and analysis of the characteristics and techniques of consultation in the various fields of social work practice. Prerequisites: SocW. 443 and 403 or 413.

409.   CRISIS INTERVENTION. 2 TO 4 HOURS. Examination of theoretical formulations of crisis intervention and study of their applicability to short-term treatment methods; emphasis on the process of short-term treatment as related to social work methods. Prerequisite: SocW. 403 or consent of the instructor and the adviser.

411.   SOCIAL GROUP WORK I. 2 TO 4 HOURS. Group-work methods, with focus on the worker's problems and procedures in understanding the group, its objectives, and its relationship to the agency. Beginning formulation of the worker's role in reference to assessment, interaction, analysis and small-group theory.

412.   SOCIAL GROUP WORK II. 2 TO 4 HOURS. Further emphasis on group methods, with intensive application of understanding and working with individuals in the group and in the agency. Social work practice with groups, including relationship, use of program, and the helping processes. Prerequisite: SocW. 411.

413.   SOCIAL GROUP WORK III. 2 TO 4 HOURS. The integration of concepts in the worker's role with the individual and the group; the referral processes. The worker's role as a strategy of intervention is developed. Prerequisite: SocW. 412.

414.   SOCIAL GROUP WORK IV. 2 TO 4 HOURS. Advanced principles of social group work in direct service with the group, advanced group theory, and concepts of group stress and crisis situations. The development of criteria for analysis of the worker's role. Prerequisite: SocW. 413.

415.   SOCIAL GROUP WORK V. 2 TO 4 HOURS. Further development of the concepts of the worker's role in direct service, with refinements illustrated from analysis of treatment groups in special settings. Work with individuals, family groups, and interdisciplinary elements in collaboration. Prerequisite: SocW. 414.

416.   SOCIAL GROUP WORK VI. 2 TO 4 HOURS. The final course in the group-work sequence. Assists the student in the integration of method and analysis of his own practice. Emphasis is on the wider role of organizing and supervising group services. Selected concepts of subexecutive and supervisory functions are identified. Current issues and new modalities in social work with groups are developed. Prerequisite: SocW. 415.

418.   GROUP TREATMENT OF ADOLESCENTS. 2 TO 4 HOURS. Professional practice in social work; methods and techniques for working with adolescents in group treatment; review of methods of group treatment and their relevance in the treatment of adolescents. Prerequisites: SocW. 443 and 413 or an equivalent course in group process.

419. THE ADOLESCENT AND HIS FAMILY GROUP. 3 HOURS. Designed to promote diagnostic understanding of the adolescent and the family group with which he lives. Developmental study of the growth of families, the impact of an adolescent on the family system, and impact of the family system on the adolescent. Both normal and abnormal development are considered. Prerequisites: SocW. 443 and an introductory course in group process.

421. COMBINED TREATMENT METHODS I. 2 TO 4 HOURS. Identification of components of social work practice, including underlying philosophy, concepts, generic principles, values, and methods of social casework and group work. Similarities and differences in the two primary social work treatment methods are considered. Emphasis on the social worker's role in offering service through a professional relationship in case and group situations. Prerequisite: Undergraduate degree or consent of the instructor.

422. COMBINED TREATMENT METHODS II. 2 TO 4 HOURS. Examination of social work practice theory through the development of different casework and group approaches. The worker's role is analyzed in terms of specific intervention strategies based on different theoretical orientations. A conceptual model framework is utilized to compare theories. Casework and group work models are analyzed separately and compared. Prerequisite: SocW. 421.

423. COMBINED TREATMENT METHODS III. 2 TO 4 HOURS. Integration and application of social casework and group-work concepts to social work practice. Emphasis on the worker's activity in serving clients with different kinds of problems in different social work settings. Examination of generic and specific aspects of casework and group work practice. Prerequisite: SocW. 422.

425. COMMUNITY ORGANIZATION. 2 TO 4 HOURS. Principles, concepts, and methods of community organization in social work at the neighborhood, local, state, national, and international levels.

431. FIELD INSTRUCTION I. 3 TO 6 HOURS. The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to agency clientele. Prerequisite: SocW. 401 or 411, which must precede or be taken concurrently.

432. FIELD INSTRUCTION II. 2 TO 6 HOURS. The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 402 or 412, which must precede or be taken concurrently.

433. FIELD INSTRUCTION III. 3 TO 6 HOURS. The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 403 or 413, which must precede or be taken concurrently.

434. FIELD INSTRUCTION IV. 4 TO 8 HOURS. The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases

or groups for direct service to the agency clientele. Prerequisite: SocW. 404 or 414, which must precede or be taken concurrently.

435.   FIELD INSTRUCTION V. 4 TO 8 HOURS. The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 405 or 415, which must precede or be taken concurrently.

436.   FIELD INSTRUCTION VI. 4 TO 8 HOURS. The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 406 or 416, which must precede or be taken concurrently.

437.   OBSERVATION—SIMULATION LABORATORY. 2 TO 4 HOURS. Observation and simulations of a broad range of organization and planning experiences, coordinating basic theories presented in introductory community organization courses with contemporary practice. Prerequisite: Credit or concurrent registration in SocW. 425.

438.   PRACTICE LABORATORY. 4 TO 8 HOURS. Student-faculty team with community organizations or agencies in problem-solving projects. Development of specific plans, program proposals, or evaluation reports. Focus on beginning practice skills. Prerequisite: SocW. 437.

439.   EXTERNSHIP IN COMMUNITY PRACTICE. 8 TO 12 HOURS. Intensive field experience under professional supervision in a community organization or planning agency in conjunction with faculty-led practice seminars. Externships provide a range of skill development in community organization and planning practice. Prerequisite: SocW. 438 or 433.

441.   HUMAN GROWTH AND BEHAVIOR I. 3 TO 6 HOURS. The major forces influencing the growth and behavior of the individual from birth through adolescence. Sociocultural, familial, physical, emotional, and intellectual factors as they enhance or retard social functioning. The relevance of this content to the profession of social work is constantly considered.

442.   HUMAN GROWTH AND BEHAVIOR II. 3 TO 6 HOURS. The individual's growth and behavior from early through late adulthood. Considerations of the essential developmental tasks and central conflicts for each major life phase, with attention focused on differentiating kinds of knowledge about personality and social functioning. Prerequisite: SocW. 441.

443.   HUMAN GROWTH AND BEHAVIOR III. 3 TO 6 HOURS. The nature and dynamics of social processes as related to growth and behavior. Study is centered on various groups within society—the family, class, ethnic group, and caste—and on the manner in which they influence individual personality development. The process of interaction and the meaning of membership within small groups is studied. Consideration is given to role expectations and the dynamics of small-group membership, particularly in the family. Attention is focused on the continuous process of change in group life and its effect on behavior. Prerequisite: SocW. 442.

444. TREATMENT ASPECTS OF REHABILITATION. 2 TO 4 HOURS. Study and analysis of the impact of catastrophic illness, disease, and rehabilitation procedures on the individual and his family; emphasis on the role of the social worker. Prerequisite: SocW. 443.

445. HUMAN GROWTH AND BEHAVIOR V. 3 TO 6 HOURS. Psychopathology, including neuroses, psychoses, character disorders, psychosomatic dysfunction, organic conditions, and mental retardation. Discussion of diagnosis and treatment methods, including psychotherapy, somatic and drug therapies, and social work. Prerequisite: SocW. 444.

446. ANALYSIS AND STUDY OF PROBLEMS OF THE AGING. 3 HOURS. The physical, psychic, and economic aspects of aging with reference to the contribution of ego psychology and certain social science theories. The relevance of such study to the provision of social services to individuals and groups and the planning of comprehensive health services are stressed. Prerequisite: SocW. 443 or consent of the instructor and the student's adviser.

447. HUMAN SEXUALITY: SOCIAL WORK APPLICATIONS. 2 TO 4 HOURS. How sexuality develops and is manifested and how it serves as an expression of self-image in normal and maladjustive behavior. Teaching of skills in dealing knowledgeably and sensitively with sexual concerns to help students feel more comfortable with their professional role in dealing with the intimate interactions of persons.

448. DRUG ABUSE AND SOCIAL WORK PRACTICE. 2 TO 4 HOURS. Major classes of drugs and other abused substances. The pharmacological, psychological, and sociological factors that relate to drug abuse; an evaluation of treatment methods, including medical, psychiatric, and therapeutic; enforcement of drug laws as a means of control; the role of the social worker in the field of drug abuse.

449. MAJORITY AND MINORITY CULTURAL INTERACTION. 2 TO 4 HOURS. Critical examination of the nature and development of status and economic factors likely to be important in accounting for majority and minority cultural interaction. Analysis of various conditions under which competition with minorities may or may not result in discrimination. Implications of this analysis for social work practice and the role of the professional social worker.

451. COMMUNITY PROBLEM SOLVING. 2 TO 4 HOURS. Introduction to the nature and scope of social work intervention at the community level. Analysis of distinctive characteristics of the community as the locus for various social systems; emphasis on their implications for practice. Appropriate methods of problem solving. Prerequisite: SocW. 425.

452. COMMUNITY DEVELOPMENT. 2 TO 4 HOURS. Community development theory and practice are analyzed and evaluated with given practitioner roles, community resources, client systems, and other means of change and development as affected by a variety of social, cultural, political, economic, geographic, and historical considerations, both foreign and domestic. Emphasis on the conditions students are likely to encounter in actual practice. Prerequisite: SocW. 451.

453. COMMUNITY PLANNING. 2 TO 4 HOURS. A range of approaches to community planning; special emphasis on their application to the development and implementation of social welfare programs. Examination of various levels of planning together with their relationship to other planning professions. Professional skills included are technical data collection, political processes, grantmanship, citizen involvement, advocacy roles, and models for evaluation. Prerequisite: SocW. 451.

461. SPECIAL STUDIES IN SOCIAL WORK I. 2 TO 6 HOURS. Independent or group study in areas of special interest; application of social work principles to special problems or settings.

471. SOCIAL SERVICES AND WELFARE POLICY I. 2 TO 4 HOURS. The function, nature, and scope of the social welfare institution. Social services as a response to social, personal, and economic problems of people. Effects of economic and social growth and change on the welfare enterprise.

472. SOCIAL SERVICES AND WELFARE POLICY II. 2 TO 4 HOURS. Social Work 472 and 473 will cover current provisions and alternatives for their solution in the social security and money assistance programs. Prerequisite: SocW. 471.

473. SOCIAL SERVICES AND WELFARE POLICY III. 2 TO 4 HOURS. Continues Social Work 472. Prerequisite: SocW. 472.

474. SOCIAL SERVICES AND WELFARE POLICY IV. 2 TO 4 HOURS. Current provisions and critical evaluation of welfare policy issues; alternatives for their solution in the social services for the aged, children, court wards, and the mentally and physically ill. Prerequisite: SocW. 473.

475. SOCIAL SERVICES AND WELFARE POLICY V. 2 TO 4 HOURS. Continues Social Work 474. Prerequisite: SocW. 474.

476. ADMINISTRATION IN SOCIAL WORK. 2 TO 4 HOURS. Principles, concepts, and processes in social work administration. Special emphasis on leadership, policy and decision making, planning, and program organization.

490. EVALUATIVE RESEARCH ON SOCIAL SERVICE EFFECTIVENESS. 4 HOURS. Review and assessment of empirical research on the results of social service intervention; concepts, criteria, and methodology of such research; the state of knowledge concerning effectiveness of social services and areas of further inquiry; the application of theory and research tools from allied disciplines. Prerequisite: SocW. 494.

493. SOCIAL RESEARCH I. 2 TO 4 HOURS. Objectives of social research, design of experiments, and measurement and methods of collecting data.

494. SOCIAL RESEARCH II. 2 TO 4 HOURS. Continues Social Work 493. Design of questionnaires and schedules; methods of data analysis, including statistical hypothesis testing and applications of inferential techniques; interpretation of results; preparation of the report; review of selected studies. Prerequisite: SocW. 493.

495.   RESEARCH SEMINAR: SOCIAL SERVICE ISSUES. 2 TO 4 HOURS.
       Methodologies and results of research in selected fields and methods of social
       services; special issues and problems in practice; relationship of research, theory,
       and practice; priorities for future research. Prerequisite: SocW. 494.

496.   RESEARCH SEMINAR: SOCIAL WELFARE MANPOWER DEVELOPMENT
       AND UTILIZATION. 2 TO 4 HOURS. The social welfare manpower system and
       the demand, supply, and utilization of subsystems. Consideration of recruitment,
       organization, function, development, and evaluation of staff and the concepts of
       professionalization and new careers. Review of empirical research, agency
       experience, conceptual models, and manpower planning efforts. Prerequisites:
       SocW. 433, 473, and 494.

497.   RESEARCH SEMINAR: METHODOLOGIES IN SOCIAL WORK RESEARCH. 2
       TO 4 HOURS. Selected research techniques; assessment, application, innovation.
       Systems analysis; social indicators; planning, programming, and budgeting
       systems; cost-benefit analysis; evaluative research; case analysis methods;
       cybernetics; information systems. Prerequisite: SocW. 494.

498.   RESEARCH PROJECT. 0 TO 12 HOURS. Application of research methods to a
       social work problem in an individual or group project or a library research project
       conducted by an individual student. Preparation of a formal report based on field
       study processes and findings. Prerequisite: SocW. 494.

499.   THESIS RESEARCH. 0 TO 16 HOURS. Individual research, under faculty
       direction, on social work problems. Prerequisites: SocW. 494 or the equivalent
       and consent of the thesis adviser.

SOCIOLOGY

Professors: David B. Carpenter, Head of the Department; Bernard H. Baum,
M. Rue Bucher, James T. Carey, Robert E. Corley, Robert L. Hall, John W.C.
Johnstone, Roger W. Little, Mildred A. Schwartz, Ethel Shanas

Associate Professors: Kathleen S. Crittenden, William W. Erbe, Associate
Head of the Department; John W. Martin

Assistant Professors: Janet M. Alger, Steven F. Alger, Daniel J. Amick,
Pauline B. Bart, R. Michael Buren, Butler P. Crittenden, Phyllis A. Ewer,
Hazel S. Fisher, Helen R. Miller, James L. Norr, Gerald M. Swatez, Larry
Tifft, Mary Glenn Wiley

    The Department of Sociology offers work leading to the Master of Arts
and the Doctor of Philosophy.
    The program for the Master of Arts is in general sociology; it provides
basic familiarity with the concepts, techniques, and substance of three broad
subfields—social organization, social psychology, and demography and human
ecology.

The program leading to the Doctor of Philosophy in Sociology has dual goals: to provide each student with advanced knowledge in a specialized area of sociology and to train each student to plan, conduct, and report empirical research in sociology.

Admission Requirements

Grade-Point Average: 4.00 (A=5.00) for the last two years of undergraduate work. A student whose average is between 3.75 and 4.00 may petition for consideration.

Graduate Record Examination: Satisfactory scores on the aptitude tests (verbal and quantitative). The advanced test in sociology is required as an aid in advising students, but it will not be a factor in admission.

Students without strong undergraduate preparation in sociology are encouraged to apply if they meet the above standards. They will be required to complete extra courses to make up deficiencies.

Students who have completed some graduate study elsewhere must, in addition to the above requirements, offer a grade-point average of 4.50 in previous graduate study. Training in logic, philosophy of science, mathematics, and statistics is strongly recommended for those who expect to pursue a graduate degree in sociology. Admission preference is given to students who have completed such training.

Master of Arts

Hours: 48 quarter hours, including 12 hours in Sociology 400, 401, 402, Theory and Method in Sociology; 8 hours in seminars at the 400 level; and either Sociology 300 or 301.

Comprehensive Examination: A candidate must satisfactorily complete a comprehensive examination.

Doctor of Philosophy

Hours: 144 quarter hours beyond the bachelor's degree or 96 hours beyond the master's degree.

In addition to satisfying the general requirements of the Graduate College, students must complete graduate courses, selected in consultation with the student's major adviser, that include Sociology 400, 401, and 402 and may include 24 hours in courses outside of sociology if the adviser approves. The student must successfully complete a qualifying examination in general sociology, which is given at the discretion of the department, and a

preliminary examination in his area of specialization. A Ph.D. candidate must present evidence acceptable to his examining committee that he: (a) has had supervised experience in empirical research, including the use of more than one major technique of research; (b) has had successful experience in the clear presentation of sociological materials to students; and (c) has knowledge of statistics at least equivalent to that available in Sociology 302.

Thesis: Candidates must prepare a dissertation based upon empirical research.

Courses for Graduate and Advanced Undergraduate Students

300. EXPLORATORY SOCIAL DATA ANALYSIS. 4 HOURS. 3 hours of lecture-discussion, 2 hours of laboratory per week. Introduction to the analysis of social data; relationship between data analysis and measurement operations; transformations of data; construction of indices; graphic display of data; analysis and interpretation of residuals. Prerequisites: Soc. 201 and 8 hours of upper-division sociology.

301. SOCIOLOGICAL STATISTICS. 4 HOURS. 3 hours of lecture, 2 hours of laboratory per week. Intended primarily for graduate students and advanced undergraduate sociology majors. Introduction to statistical tests of sociological hypotheses; estimation procedures; selected statistical procedures commonly used in sociology. Prerequisite: Graduate or upper-division standing.

302. ADVANCED STATISTICS IN SOCIOLOGY. 4 HOURS. Analysis of contingency tables; multiple and partial, linear and nonlinear correlation; analysis of variance. Prerequisite: Soc. 301.

305. RESEARCH TECHNIQUES IN SOCIOLOGY. 4 HOURS. 3 hours of lecture-discussion, 2 hours of laboratory per week. Several common techniques of collecting and organizing sociological data, such as questionnaires and interview schedules, systematic observation, scaling, nonreactive measures, content analysis. Prerequisites: 8 hours of upper-division sociology and consent of the instructor.

306. RESEARCH DESIGN IN SOCIOLOGY. 4 HOURS. Formulation of researchable problems; designing research procedures and selecting techniques to fit particular objectives; planning controls to distinguish among alternative hypotheses. Prerequisite: Soc. 301.

314. SOCIAL PSYCHOLOGY OF ORGANIZATIONS. 4 HOURS. Sociological analysis of the mutual influence of individuals and social organization through such organizational processes as recruitment, socialization, interaction, innovation, and social control. The entire range of social organizations is considered, such as polities, social movements, communities, bureaucracies, families, gangs, friendships, encounters. Prerequisites: Soc. 110 or 210 and 8 hours of upper-division sociology.

316. ADULT SOCIALIZATION. 4 HOURS. Socialization as a process of induction into new roles, which occurs throughout the life cycle; the process is analyzed at

both social-psychological and social-systems levels with illustrations from various settings, such as marriage and family, illness, migration, and particularly socialization into occupations and professions. Prerequisite: 8 hours of sociology at the 200 or 300 level.

318. **SOCIOLOGY OF LITERATURE. 4 HOURS.** How literature is influenced and in turn influences social forces; effects of social class, political and economic factors, and religious, ethnic, and racial affiliations on literary works; attitudes of writers, relationships to publics, reward systems, and related matters. Prerequisites: 8 hours of upper-division sociology and 6 hours of literature (any department).

319. **TOPICS IN SOCIAL PSYCHOLOGY. 4 HOURS.** May be repeated for up to 12 hours of credit. Intensive analysis of a specialized topic. Each topic is announced at the time the class is scheduled. Prerequisites: Soc. 110 or 210 and 8 hours of upper-division sociology.

325. **AGE GROUPS AND THE SOCIAL ORDER. 4 HOURS.** The relation of age groups to social structure; the demographic, sociological, and social-psychological conditions affecting the salience of age as a basis of social organization; recent writings on adolescents and youth; the theory of subcultures as applied to youth groups; relations between generations; current directions in the study of youth groups, both conventional and deviant. Prerequisite: 4 hours of upper-division sociology.

333. **SOCIOLOGY OF LAW. 4 HOURS.** Same as Criminal Justice 333. The origin and development of legal norms in various social settings; their relationship to custom and incorporation in legal and quasi-legal institutions; special attention to the difference between legal and sociological reasoning; law as an instrument of social change. Prerequisite: 8 hours of upper-division sociology, including Soc. 230 or CrJ. 230.

335. **TOPICS IN DEVIANCE AND SOCIAL CONTROL. 4 HOURS.** May be repeated for up to 12 hours of credit. Intensive analysis of a specialized topic in the sociology of law, deviance, and social control. Each topic is announced at the time the class is scheduled. Prerequisite: 8 hours of upper-division sociology, including Soc. 230.

341. **SOCIAL STRATIFICATION AND CLASSES. 4 HOURS.** Nature and systems of differentiation and ranking in societies, emphasis on the class structure in the United States; life chances, prestige, status, power and social mobility in the United States and other societies. Prerequisite: 8 hours of upper-division sociology.

343. **TOPICS IN THE SOCIOLOGY OF EDUCATION. 4 HOURS.** May be repeated for credit up to a total of 12 hours. Intensive examination of a specialized topic, which is announced each time the course is scheduled. Prerequisites: 8 hours of upper-division sociology and consent of the instructor.

344. **INDUSTRIAL SOCIOLOGY. 4 HOURS.** Analysis of industrial institutions in contemporary society; management, labor, and the community. Prerequisite: 8 hours of sociology.

345.   THE SOCIOLOGY OF THE FAMILY. 4 HOURS. The family as a social
        institution; its functions and forms in contemporary society. Prerequisite: 8 hours
        of sociology.

346.   SOCIOLOGY OF SCIENCE. 4 HOURS. Organization of the scientific enterprise;
        emergence of science as a social institution; interrelations with other institutions,
        such as government, religion, economy, and the arts. Science as a social
        phenomenon; regularities in scientific behavior; consideration of both historical
        and contemporary material. Prerequisite: 8 hours of sociology.

347.   SOCIOLOGY OF COMPLEX ORGANIZATIONS. 4 HOURS. Characteristics of
        business, government agencies, schools, hospitals, and other large-scale
        organizations, approaches used to study organizations, and theoretical and
        empirical analysis of organizational processes. Prerequisites: Senior standing and 8
        hours of sociology.

348.   TOPICS IN THE SOCIOLOGY OF WAR. 4 HOURS. Intensive analysis of selected
        topics, including comparative military organization, the relationships between
        military institutions and other institutions of the larger society, their roles in
        social conflict and change. Prerequisites: Soc. 100 and 12 hours of either
        sociology, political science, history, or economics.

349.   SOCIOLOGY OF OCCUPATIONS AND PROFESSIONS. 4 HOURS. Theoretical
        and empirical analysis of the occupational structure and occupational mobility
        processes in American and other industrial societies; patterns of recruitment and
        retention in occupations and professions. Prerequisite: Soc. 203.

351.   MEDICAL SOCIOLOGY. 4 HOURS. Sociological contributions to medicine and
        public health; social organization and the organization of health services; the
        sociology of illness. Prerequisite: 8 hours of upper-division sociology.

352.   SOCIAL EPIDEMIOLOGY: SOCIAL AND CULTURAL FACTORS IN HEALTH
        AND DISEASE. 4 HOURS. The methods of social epidemiology as they apply to
        chronic and acute disease; psychosocial factors in illness; individual and social
        reactions to health and disease. Prerequisite: 8 hours of upper-division sociology.

353.   HEALTH CARE SYSTEMS. 4 HOURS. The organization of medical care in the
        United States and other selected countries. Methods of delivering medical care to
        various populations; emphasis on urban medicine. Prerequisite: 8 hours of
        upper-division sociology.

354.   URBAN MEDICINE. 2 HOURS. Same as Preventive Medicine and Community
        Health 399B (College of Medicine). A combination of preceptorship and
        seminar-discussion for advanced clinical students; several models of the urban
        health care setting are examined by direct participation; seminar topics evaluate
        the nature of and factors contributing to each of the study models; opportunity
        for critical observation and evaluation of special-interest areas, such as private
        practice, group practice, private hospital, public hospital, health department and
        public health programs, health care plans, neighborhood health centers, and
        others as student interest dictates. Prerequisite: Consent of the instructor.

355. TOPICS IN MEDICAL SOCIOLOGY. 4 HOURS. May be repeated for up to 12 hours of credit. Intensive analysis of the methods and literature in a selected subfield of medical sociology. Each topic is announced at the time the class is scheduled. Prerequisites: Soc. 351 and consent of the instructor.

357. FIELD EXPERIENCE IN MEDICAL SOCIOLOGY. 2 TO 12 HOURS. Field placement in a medical institution for sociology students. Critical observation and the application of sociological concepts in the study of special-interest areas, such as the role of the patient, patient-doctor relationship, and socialization into the health professions. Prerequisites: 12 hours of upper-division sociology, including Soc. 351 or 352 or Soc. 353, and consent of the instructor.

361. SOCIAL GERONTOLOGY: OLD PEOPLE IN AMERICA. 4 HOURS. The aged: demographic trends, economic status, physical and social needs, family relationships. Prerequisite: 8 hours of upper-division sociology.

365. TOPICS IN THE SOCIOLOGY OF POLITICS. 4 HOURS. May be repeated for up to 12 hours of credit. Intensive analysis of a specialized topic concerning the sociological study of politics. Each topic is announced at the time the class is scheduled. Prerequisites: 8 hours of upper-division sociology and consent of the instructor. Sociology 265 is recommended.

366. COMMUNITY POWER STRUCTURE. 4 HOURS. Analysis of the power structure of American communities; special emphasis on the relation between theoretical assumptions and research procedures in current community studies. Prerequisite: 12 hours of sociology.

371. POPULATION I. 4 HOURS. 2 hours of lecture, 2 hours of laboratory-discussion per week. Primarily for sociology majors and graduate students. The measurement and study of major trends and differentials in fertility, mortality, population growth, and age-sex composition in the United States and other countries. Emphasis on social and cultural determinants and consequences. Prerequisite: 12 hours of sociology, including Soc. 201 or the equivalent.

372. POPULATION II. 4 HOURS. 2 hours of lecture, 2 hours of laboratory-discussion per week. The measurement and study of major trends in migration, population composition, and marriage and divorce in the United States and other countries; theories and policies regarding population growth in relation to resources; population forecasting. Prerequisite: Soc. 371.

373. HUMAN ECOLOGY. 4 HOURS. The relationship between man and the natural environment. Emphasis on importance of population patterns and human institutions in adaptation. Prerequisite: 12 hours of sociology, including Soc. 201 or the equivalent.

375. TOPICS IN POPULATION AND HUMAN ECOLOGY. 4 HOURS. May be repeated for up to 12 hours of credit. Intensive analysis of a specialized topic on population or human ecology. Each topic is announced at the time the class is scheduled. Prerequisites: 8 hours of upper-division sociology and consent of the instructor.

376.   TOPICS IN URBAN SOCIOLOGY. 4 HOURS. May be repeated for up to 12
         hours of credit. Intensive analysis of a specialized topic. Each topic is announced
         at the time the class is scheduled. Prerequisites: 8 hours of upper-division
         sociology and consent of the instructor.

381.   TOPICS IN SOCIAL CHANGE. 4 HOURS. Intensive analysis of a specialized
         topic on processes of social change. Each topic is announced at the time the class
         is scheduled. Prerequisites: 8 hours of upper-division sociology and consent of the
         instructor.

384.   TOPICS IN SOCIOLOGICAL THEORY CONSTRUCTION. 4 HOURS. Intensive
         study of various topics in contemporary sociological construction. Prerequisite:
         Soc. 202.

385.   HISTORY OF EUROPEAN SOCIOLOGICAL THEORY. 4 HOURS. European
         foundations of modern sociology from the French Revolution through the
         aftermath of World War I, with emphasis on selected European theorists who have
         had a strong impact on modern sociology. Their works are viewed both
         analytically and historically. Prerequisite: 8 hours of upper-division sociology.

386.   HISTORY OF AMERICAN SOCIOLOGICAL THEORY. 4 HOURS. American
         foundations of modern sociology from the Civil War to World War II, with
         emphasis on selected American theorists who have had a strong impact on
         contemporary sociology. Their works are viewed both analytically and
         historically. Prerequisite: 8 hours of upper-division sociology.

387.   CONTEMPORARY SOCIOLOGICAL THEORY. 4 HOURS. Issues and thinkers
         associated with the development of sociological theory since World War II,
         presented analytically and in terms of the social context in which it was written.
         Stress on the implications of recent work for future research. Prerequisite: 8
         hours of upper-division sociology.

389.   INDEPENDENT STUDY. 2 TO 12 HOURS. Supervised study projects for
         graduate students and honors undergraduates; may consist of extensive readings in
         specialized areas of sociology or empirical research; exclusive of credit given under
         Sociology 499. Prerequisites: Soc. 203, 20 hours of sociology, and approval of the
         department.

395.   TOPICS IN SOCIAL ORGANIZATION AND INSTITUTIONS. 4 HOURS. May
         be repeated for up to 12 hours of credit. Intensive analysis of a specialized topic.
         Prerequisites: 8 hours of upper-division sociology and consent of the instructor.

Courses for Graduate Students

400.   THEORY AND METHOD IN SOCIOLOGY. 4 HOURS. Detailed examination of
         middle-range theories, such as compliant behavior, status congruence, and
         intervening opportunities in migration; the means of bringing evidence to bear on

them. Emphasis on the link between theoretical assertions and data. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Consent of the instructor.

401. THEORY AND METHOD IN SOCIOLOGY. 4 HOURS. Continues Sociology 400. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Soc. 400.

402. THEORY AND METHOD IN SOCIOLOGY. 4 HOURS. Continues Sociology 400 and 401. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Soc. 401.

404. RESEARCH METHODS PRACTICUM. 2 TO 6 HOURS. May be repeated with the approval of the department. Supervised experience in the use of specialized techniques of sociological research. Topic is announced when the class is scheduled. The practicum is usually offered in a three-quarter sequence. Prerequisite: Consent of the instructor.

409. SEMINAR: SOCIOLOGICAL RESEARCH METHODS. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of specialized topics. Prerequisite: Consent of the instructor.

411. SMALL GROUPS: STRUCTURE AND PROCESS. 4 HOURS. Same as Psychology 411. Systematic survey of research and theory dealing with social interaction and social relationships in small groups; primary groups as agents of social influence and social control. Prerequisite: Consent of the instructor.

419. SEMINAR: SOCIAL PSYCHOLOGY. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of specialized topics. Prerequisite: Consent of the instructor.

429. SEMINAR: SOCIOLOGICAL THEORY. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of specialized topics. Prerequisite: Consent of the instructor.

439. SEMINAR: DEVIANCE AND SOCIAL CONTROL. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of specialized topics. Prerequisite: Consent of the instructor.

449. SEMINAR ON SOCIAL ORGANIZATION. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of specialized topics. Prerequisite: Consent of the instructor.

459. SEMINAR: SOCIOLOGY OF MEDICINE. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of special topics. Prerequisite: Consent of the instructor.

469. SEMINAR: SOCIOLOGY OF POLITICS. 2 TO 6 hours. May be repeated for credit up to a total of 16 hours. Intensive analysis of special topics. Prerequisite: Consent of the instructor.

476. SEMINAR: SOCIOLOGY OF URBAN LIFE. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of specialized topics. Prerequisite: Graduate standing in sociology.

479. SEMINAR: POPULATION AND HUMAN ECOLOGY. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of special topics. Prerequisite: Consent of the instructor.

489. SEMINAR: SOCIAL INSTITUTIONS. 2 TO 6 HOURS. May be repeated for credit up to a total of 16 hours. Intensive analysis of specialized topics. Prerequisite: Consent of the instructor.

490. COLLOQUIUM ON COLLEGE TEACHING OF SOCIOLOGY. 4 HOURS. Sociological analysis of contemporary university teaching; specific information and techniques for the presentation of sociology at the college level. Prerequisite: One quarter of graduate study.

498. SUPERVISED RESEARCH IN SOCIOLOGY. 2 TO 8 HOURS. May be repeated for credit. Research on special problems not included in a graduate thesis. Prerequisites: Consent of the instructor and approval of the department.

499. THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Register under this course number.

SPANISH

Professors: Brian Dutton, Head of the Department; Eduardo Betoret-Paris, Audrey Kouvel, José Sánchez

Associate Professors: Violet B. Bergquist, Manuel Blanco-Gonzalez, Ruth El Saffar, Klaus Mueller-Bergh

Assistant Professors: Lucille V. Braun, James D. Compton, Margherita M. Harwell, Jerry Rank, Henry W. Sullivan

The department offers an Intercampus Program with the Urbana-Champaign campus of the University of Illinois leading to a Master of Arts in Spanish. Since the degree will actually be granted by the Urbana-Champaign campus, a student must register at Chicago Circle as an unassigned graduate student. Three areas of specialization are offered: applied linguistics and teaching, Latin American studies, and peninsular studies.

Admission Requirements:

The department requires a minimum grade-point average of 3.75 (A=5.00), usually with a 4.00 (B) average in major Spanish courses.

All inquiries should be addressed to the Chairman of the Graduate Committee, Department of Spanish, Italian, and Portuguese, University of Illinois at Chicago Circle, Box 4348, Chicago, Illinois 60680.

Degree Requirements:

A minimum of 48 quarter hours is required; 12 hours must be in Spanish 499, Thesis Research, and at least 12 of the remaining 36 quarter hours of course work must be at the 400 level, including one of the colloquia, Spanish 401, 402, 404, and one Spanish 400-level seminar.

The student is required to maintain a 4.00 (B) average, and no credit is given for a course in which the grade is less than B.

Courses for Graduate and Advanced Undergraduate Students

301. CONTEMPORARY SPANISH POETRY. 4 HOURS. From Modernism to the present. Readings and interpretation of the works of some of the best poets of the period. Prerequisite: Span. 219 or 221.

302. CONTEMPORARY SPANISH THEATER. 4 HOURS. Plays of some of the best known contemporary authors, from Benavente to Sastre. Prerequisite: Span. 219 or 221.

303. NINETEENTH CENTURY SPANISH NON-ROMANTIC DRAMA. 4 HOURS. Representative outlines of non-Romantic plays, their characteristics and development. Prerequisite: Span. 219 or 221.

305. SPANISH ROMANTICISM. 4 HOURS. Representative works of the Romantic period; particular emphasis on Romantic drama and poetry. Prerequisite: Span. 219 or 221.

306. REALISM IN NINETEENTH CENTURY SPANISH LITERATURE. 4 HOURS. Continues Spanish 305. Prerequisite: Span. 219 or 221.

307. THE GENERATION OF 1898. 4 HOURS. Representative works of Baroja, Azorín, Unamuno, Maeztu, Valle Inclán, Benavente, A. Machado, and others. Prerequisite: Span. 219 or 221.

308. SPANISH-AMERICAN LITERATURE TO 1888 I. 4 HOURS. Same as Latin American Studies 308. Development from the sixteenth century through the end of the Romantic period. Prerequisite: Span. 223 or 224 or the equivalent.

309. SPANISH-AMERICAN LITERATURE TO 1888 II. 4 HOURS. Same as Latin American Studies 309. Continues Spanish 308. Prerequisite: Span. 223 or 224.

310. *MODERNISMO* AND CONTEMPORARY SPANISH-AMERICAN POETRY I. 4 HOURS. Same as Latin American Studies 310. Spanish-American poetry from 1888 to the present with some *Modernista* prose. Prerequisite: Span. 223 or 224.

311. *MODERNISMO* AND CONTEMPORARY SPANISH-AMERICAN POETRY II. 4 HOURS. Same as Latin American Studies 311. Continues Spanish 310. Prerequisite: Span. 223 or 224.

314. POETRY OF THE GOLDEN AGE. 4 HOURS. The development of Spanish lyric poetry out of both popular and classical sources. *Romances,* Renaissance poetry, mystic poetry, *culturanismo,* and *conceptismo.* Prerequisite: Span. 218.

315. DRAMA OF THE GOLDEN AGE. 4 HOURS. Development of Spanish theater in the Golden Age; detailed study of plays by Lope de Vega, Tirso de Molina, Calderón, and other representative dramatists. Prerequisite: Span. 218.

317. PROSE OF THE GOLDEN AGE. 4 HOURS. Major examples of picaresque, pastoral, and chivalric forms. Prerequisite: Span. 218.

318. MINOR WORKS OF CERVANTES. 4 HOURS. The prose of Cervantes and its relationship to his masterpiece. Prerequisite: Span. 218.

319. *DON QUIJOTE.* 4 HOURS. Same as Humanities 319. Reading and discussion; emphasis on novelistic technique and the development of the novel. Prerequisite: Span. 218.

320. THE CONTEMPORARY SPANISH NOVEL. 4 HOURS. Development since 1936. Prerequisite: Span. 219 or 221.

321. THE CONTEMPORARY SPANISH NOVEL. 4 HOURS. Continues Spanish 320. Prerequisite: Span. 219 or 221.

322. REGIONALISM AND POPULARISM IN THE SPANISH NOVEL. 4 HOURS. Origins, development, characteristics, and significance of regionalism-popularism in Spanish literature and its relation to Spanish regions. Prerequisite: Span. 219.

323. THE CONTEMPORARY SPANISH-AMERICAN NOVEL I. 4 HOURS. Same as Latin American Studies 323. From the Romantic period to 1930. Prerequisite: Span. 223 or 224 or the equivalent.

324. THE CONTEMPORARY SPANISH-AMERICAN NOVEL II. 4 HOURS. Same as Latin American Studies 324. Continues Spanish 323. From 1930 to the present. Prerequisite: Span. 223 or 224.

340. HISTORY OF THE SPANISH LANGUAGE. 4 HOURS. General survey of the development of the Spanish language. Prerequisite: Consent of the instructor.

341. STUDIES IN PENINSULAR LANGUAGES. 4 HOURS. May be repeated for credit. Dialects and languages of the Iberian Peninsula, including Catalan, Galician, Aragonese, Leonese. Topic varies from quarter to quarter. Prerequisite: Span. 340 or an equivalent course in any Romance language or approval of the department.

342. INTRODUCTION TO ROMANCE PHILOLOGY. 4 HOURS. History of the Romance Languages, especially Spanish, French, Italian, and Portuguese, from the

classical Latin period to the present; their external history, phonology, morphology, and syntax. Prerequisite: Consent of the instructor.

345. **MEDIEVAL SPANISH LITERATURE I. 4 HOURS.** Important works from the beginnings to 1400. Prerequisite: Span. 218. Spanish 340 is recommended.

346. **MEDIEVAL SPANISH LITERATURE II. 4 HOURS.** Important works of the fifteenth century. Prerequisite: Span. 218. Spanish 340 is recommended.

349. **PHONETICS. 4 HOURS.** Prerequisites: Span. 213, and 218 or 221.

361. **SPANISH ABROAD. 0 TO 15 HOURS.** May be repeated for credit for a maximum of 45 hours. Lectures, seminars, and practical work in Spain. Spanish language, literature, and civilization. Prerequisites: Span. 214 or the equivalent; Span. 218, 219 or the equivalents; 3.50 overall average; 4.00 average in Spanish courses.

371. **SPANISH FOR TEACHERS. 4 HOURS.** Consideration of those language problems suggested by teaching experience. It is recommended that this course be taken after student teaching, in the last quarter before graduation. Also open to experienced teachers. Prerequisite: Student teaching or professional teaching experience.

390. **TOPICS IN SPANISH LITERATURE. 6 HOURS.** May be repeated. Topics vary from quarter to quarter. Prerequisite: Consent of the instructor.

399. **INDEPENDENT STUDY. 1 TO 6 HOURS.** Supervised study, in an area not covered by regularly offered courses, under the direction of a faculty member designated at the discretion of the department on the request of a qualified student. Individual conferences, assigned readings and papers, and other work are required. Prerequisites: Spanish major with senior standing or graduate student in Spanish and approval of the department.

Courses for Graduate Students

401. **APPLIED LINGUISTICS AND LANGUAGE TRAINING IN SPANISH, ITALIAN, AND PORTUGUESE. 4 HOURS.** Systems of linguistic analysis in relation to language teaching via programmed instruction, audio-visual aids, TV, radio, and computer-based instruction. Practical work is required in problem areas. Prerequisite: Fluency in a Romance language.

402. **INTRODUCTION TO LATIN AMERICAN STUDIES. 4 HOURS.** Problems inherent in the concept of Latin American studies; national versus regional and Continental values; indigenous, *mestizo,* and *criollo* versus European; *hispanidad* in Latin America and the effects of non-Spanish immigration and cultural influences. Prerequisite: Consent of the instructor.

404. **INTELLECTUAL HISTORY OF SPANISH CULTURE. 4 HOURS.** The major intellectual and social movements in relation to the Spanish culture. Such topics

as feudalism, honor, courtly love, humanism, and the baroque are discussed, and their Spanish manifestations are investigated. The course centers on the origins and early growth of movements.

405. SPANISH LITERATURE OF THE EIGHTEENTH AND NINETEENTH CENTURIES. 4 HOURS. The beginnings of eighteenth-century rationalism; neo-classicism and French influence; the *sainetes* of Ramón de la Cruz; the nationalistic reaction against France during the Napoleonic Wars; liberalism and Romanticism; the *costumbrista* movement; the growth of realism and naturalism; the concern of the novel with social and religious issues; the precursors of 1898. Prerequisite: Any two of Span. 302, 305, 306 or the equivalent.

407. SPANISH LITERATURE OF THE TWENTIETH CENTURY. 4 HOURS. May be repeated twice. The generation of 1898, modernism and postmodernism, the development of non-engage literature, popularism, the Civil War and its literary consequences, the writings of the "new" Spain of the 1950's and 1960's. Prerequisites: Span. 301 and 307.

409. SPANISH LITERATURE OF THE GOLDEN AGE. 4 HOURS. May be repeated twice. Renaissance and humanistic influences, the discovery of America, the Counterreformation, the baroque, *conceptismo* and *culteranismo* as elements in the development of Spanish thought and letters in the period of 1500 to 1700. Topics vary. Prerequisite: Span. 314 or 315.

411. SPANISH LITERATURE BEFORE 1500. 4 HOURS. May be repeated twice. The growth of medieval vernacular culture, the rise of secularism, the development of a reading public, and the social changes these movements reflect. The break-up of feudalism, the changing nature of the nobility, the growth of courtly love, feminism versus antifeminism, the emergence of the bourgeoisie, the "two cultures" of the pen and the sword, and similar topics. Prerequisite: Consent of the instructor.

413. LATIN AMERICAN LITERATURE. 4 HOURS. The Caribbean, Mexico, and Central America. Reading and discussion of major literary movements, individual works, and such literary figures as Sor Juana, Galván, Hostos, Marti, Varona, Dario, Azuela, Guzmán, Asturias, Yañez, Fuentes, Reyes, Rulfo, Marqués, Bosch, and others.

425. SEMINAR: SPANISH LITERATURE OF THE TWENTIETH CENTURY. 6 HOURS. May be repeated for credit twice. An in-depth study of one of the major figures of twentieth century Spanish literature. Topics vary. Prerequisite: Consent of the instructor and of the graduate committee chairman.

440. THE SPANISH RENAISSANCE. 6 HOURS. Social, cultural, and intellectual characteristics; main periods and aspects in relation to typical authors and works from 1450 to 1600. Prerequisite: At least two courses from Span. 314, 315, 317, 318, 319, 345, 346.

445. SEMINAR ON SPANISH LITERATURE OF THE GOLDEN AGE. 6 HOURS. May be repeated twice. Monographic studies on the major figures of the Spanish Golden Age. Topics vary. Prerequisite: Approval of the department.

490.   SPECIAL SEMINAR. 6 HOURS. Topic varies. Prerequisite: Two 300-level courses in Spanish or approval of the department.

491.   INDEPENDENT STUDY. 1 TO 6 HOURS. May be repeated for credit. Available only after 18 hours of graduate credit. Designed for the study, under a graduate faculty member, of an area not otherwise available. Prerequisite: Consent of the graduate chairman.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Individual work under the supervision of a graduate faculty member. Prerequisite: Approval of the department Graduate Committee.

SPEECH AND THEATER

Professors: R. Victor Harnack, Head of the Department; Donald H. Dickinson, Grace Holt, Chester C. Long, Harry J. Skornia

Associate Professors: Thomas Kochman, Katherine Loesch, Natalie Schmitt, Barbara Wood

Assistant Professors: John Dimmick, John A. Jones

The department offers courses of study leading to the Master of Arts in Speech and Theater, with specialization in communication and public address and in theater.

Admission Requirements

Admission to the program requires a bachelor's degree from an accredited institution. Students who apply for graduate status in speech must present the equivalent of 30 quarter hours of study in speech and theater and must have achieved a grade-point average of 4.00 (A=5.00) for the last 90 quarter hours of their undergraduate work. Students who have fewer than the required 30 hours or have a grade-point average below 4.00 may petition for special consideration.

Degree Requirements

A thesis and successful completion of a comprehensive examination are required for the degree. A minimum of 48 quarter hours, including Speech 397 and at least 16 hours at the 400 level, must also be presented. Of these 48 hours, at least 36, including thesis credit (6 to 12 hours), must be in speech and theater; the remaining 12 must be either in speech or in approved courses in other departments.

Courses for Graduate and Advanced Undergraduate Students

301. COMMUNICATION ANALYSIS. 4 HOURS. Descriptions, models, proposed dimensions, and statistical treatment of the communication process. Prerequisites: Spch. 112, 113, 201 or 202, and 210.

302. GROUP COMMUNICATION THEORY. 4 HOURS. Detailed analysis and observation of group processes from the viewpoint of modern information and field communication theory. Prerequisites: Spch. 111, 112, 113, 210, and 211.

303. THEORIES OF LANGUAGE PERFORMANCE. 4 HOURS. Contemporary theories and related research in language performance, centering upon selected approaches to language acquisition and behavior; special emphasis on the psycholinguistic approach. Prerequisites: Spch. 112, 201 or 202, and 210 or the equivalent or sufficient language-linguistic background.

311. AMERICAN AND BRITISH PUBLIC ADDRESS I. 4 HOURS. Critical and historical study of American and British speakers and their speeches to 1850. Prerequisites: Spch. 111, 112, 113, and any two of Spch. 211, 212, 213.

312. AMERICAN AND BRITISH PUBLIC ADDRESS II. 4 HOURS. Continues Speech and Theater 311. From 1850 to 1920. Prerequisites: Spch. 111, 112, 113, and any two of Spch. 211, 212, 213.

313. CONTEMPORARY PUBLIC ADDRESS. 4 HOURS. Contemporary speechmaking; principal focus on issues relating to economics and government, World War II, postwar international problems, and civil rights. Prerequisites: Spch. 111, 112, 113, and any two of Spch. 211, 212, 213.

315. THE RHETORIC OF FREE SPEECH. 4 HOURS. The rhetorical processes employed by those speakers in the British House of Commons and in America who participated in the freedom of speech movements. Consideration is given to issues relating to the contemporary American scene. Prerequisites: Spch. 212 and PolS. 355.

321. EUROPEAN THEATER HISTORY I. 4 HOURS. Historical survey of the theater and theater arts of ancient Greece and Rome, medieval Europe, the Italian Renaissance, and Elizabethan England. Prerequisites: Spch. 121 and at least 8 hours of credit chosen from Spch. 241, 251, 261, 262, 264, and 265.

322. EUROPEAN THEATER HISTORY II. 4 HOURS. Historical survey of the theater and theater arts from the seventeenth century to modern times in Europe and England. Prerequisites: Spch. 122 and at least 8 hours of credit chosen from Spch. 241, 251, 261, 262, 264, and 265.

324. AMERICAN THEATER HISTORY I. 4 HOURS. Development of the American theater from 1700 to 1914; historical trends and dramatic literature. Prerequisites: Spch. 122 and at least 8 hours of credit chosen from Spch. 241, 261, 262, and 264.

325. AMERICAN THEATER HISTORY II. 4 HOURS. Development of the American theater from 1914 to the present; native and European influences in determining theatrical trends. Prerequisites: Spch. 122 and at least 8 hours of credit chosen from Spch. 241, 261, 262, and 264.

328. PLAY PRODUCTION PROSPECTUS. 4 HOURS. Seminar; emphasizes the stage director's central function in creating an artistic concept for producing a play and coordinating all elements of performance in an aesthetic unity. Historical research of a recognized classic and preparation of a complete production book. Prerequisites: Spch. 251, 264, and 265.

329. THEATRICAL CRITICISM. 4 HOURS. Seminar in the study and practice of theatrical criticism, principally modern and contemporary criticism. Historical bases of critical judgment of play and performance; function and influence of the critic in establishing artistic standards and cultivating public taste. Preparation of criticisms of current productions. Prerequisites: Spch. 122, 123, 261, and 264.

331. MASS MEDIA PROGRAMMING. 4 HOURS. Mass media program types; objectives, methods, and effects; creative development of programs from conception to script. Prerequisite: Two courses in speech including Spch. 232.

333. MASS COMMUNICATIONS SEMINAR. 4 HOURS. The nature of mass media in contemporary society. The legal and social responsibilities of mass media institutions in the United States and abroad. Prerequisite: Two courses in speech including Spch. 131.

334. WORLD BROADCASTING. 4 HOURS. The broadcast systems used by the nations of the world; alternative and "mixed" systems; international organizations, agreements, exchanges, and problems; broadcasts to and from other countries; implications of such new developments as satellites; mass and nonmass uses. Prerequisites: Spch. 113, 131, and 231.

351. SCENE DESIGN AND LIGHTING. 4 HOURS. A lecture-laboratory approach to the role of stage lighting in scene design. Analysis of historical background and sources; special emphasis on such areas as theories, psychological and aesthetic factors, and lighting application techniques and equipment. Lectures, readings, and practical problems. Prerequisite: Spch. 251.

354. THE PSYCHOLOGY OF LANGUAGE. 4 HOURS. Same as Linguistics 374 and Psychology 354. Introductory survey of methods, theory, and research; acquaints students with the history and present status of psychology's interest in language behavior. Prerequisite: Consent of the instructor.

361. PERIODS AND STYLES OF ACTING. 4 HOURS. Concentration on premodern styles of acting from these periods: classical Greece, *commedia dell'arte,* Elizabethan, Restoration and the eighteenth century, nineteenth century melodrama, and naturalism. Prerequisite: Spch. 262.

371. ADVANCED STUDY IN LANGUAGE. NO CREDIT. Intensive study of language and speech activities of elementary school children; particular attention to

children with language disabilities. Includes the study of language acquisition and applicable speech activities. Prerequisite: A baccalaureate from an accredited institution.

372. **INSTRUCTIONAL APPLICATIONS OF TELEVISION AND RADIO. 4 HOURS.** Television and radio as instructional communications media; the design of instructional materials relating the communications requirements of subject matter to communications capabilities of television and radio; production, utilization, and evaluation of instructional television and radio presentations. Prerequisites: Spch. 131 and two courses from Spch. 231, 232, 233.

374. **MEDIA INTERNSHIP. 4 TO 12 HOURS.** Media communication studies in a field setting. Students work in an approved professional field setting to investigate the uses of appropriate and relevant electronic media. Problem-solving approach; individual projects developed through conferences with a University faculty member and a department-selected field supervisor. Prerequisites: Spch. 233; consent of the department head, obtained one quarter in advance.

380. **ETHNOGRAPHY OF COMMUNICATION. 4 HOURS.** Social interaction viewed in terms of its context. The role of the investigator as participant-observer. The taxonomic method of description and analysis. Focus is on urban contexts. Prerequisite: Spch. 181.

397. **PROSEMINAR IN SPEECH AND THEATER. 4 HOURS.** Examination of research trends and methodologies appropriate to the area. Prerequisites: Graduate standing and 30 hours of credit in speech and theater.

Courses for Graduate Students

401. **EXPERIMENTAL PSYCHOLINGUISTICS. 4 HOURS.** Same as Linguistics 471 and Psychology 401. Intensive review of experimental laboratory studies concerned with the effects of phonological, syntactic, and semantic variables on sentence perception, comprehension, production, and memory in the mature language user. The relevance of the research in contemporary psycholinguistic theory is emphasized. Prerequisites: Spch. 354 or the equivalent and consent of the instructor.

404. **SEMINAR IN SPEECH AND LANGUAGE BEHAVIOR. 4 HOURS.** May be repeated for credit up to 12 hours. Speech and first-language development; speech and language differences and related communicative problems within and across subcultures; recent research in speech and language mechanisms. Prerequisite: Spch. 303.

407. **SEMINAR IN INTERPERSONAL COMMUNICATION. 4 HOURS.** Studies of problem solving in dyadic and larger small group structures. Prerequisite: Spch. 302.

413. **PROSEMINAR IN PERSUASION. 4 HOURS.** May be repeated for credit up to 12 hours. Examination of contemporary theory and research involving variables in the persuasive process. Prerequisites: Spch. 210, 213, and any one of Spch. 311, 312, 313 or 315.

421.   SEMINAR IN THEATER HISTORY. 4 HOURS. Specialized study of selected
       aspects of the American theatrical scene. Prerequisites: Spch. 324 and 325.

422.   THEORIES OF THEATER. 4 HOURS. Comparative study of the esthetics of
       theater. Nature of the theatrical experience. The function and status of theater in
       various cultures. Emphasis on modern theories. Prerequisites: At least three
       courses chosen from Spch. 321, 322, 324, 325, 328, and 329.

423.   SPECIAL TOPICS IN CRITICISM. 4 HOURS. May be repeated for credit.
       Seminar in theatrical criticism. Intensive analysis of an individual critic or school
       or critical history of an important play; preparation of original criticism, applying
       existing standards and developing the student's individual approach. Prerequisite:
       Spch. 329.

434.   INTERNATIONAL COMMUNICATION. 4 HOURS. International and regional
       efforts, activities, organizations, and problems of the mass media (electronic,
       satellite, printed); propaganda, exchanges and such regional efforts and
       organizations as Eurovision, the Asian Broadcasting Corporation, and
       International Researchers and Findings. Prerequisites: Spch. 334 and two courses
       in political science or modern world history.

439.   TELEVISION AND SOCIETY. 4 HOURS. The performance of radio and
       television in terms of content, government and industry controls, social
       responsibility, economic bases and effects. Prerequisites: Spch. 131 and 8 hours
       chosen from Spch. 231, 232, 233, 239, 331, 333, 334.

451.   THEATER ARCHITECTURE AND PRODUCTION. 4 HOURS. Seminar in
       esthetic and technical problems presented by the interrelation of theater, stage,
       audience, and play. Field study of types of Chicago theaters and stages.
       Prerequisites: Spch. 251 and 351.

495.   PROBLEMS OF TEACHING SPEECH. 4 HOURS. Seminar in teaching methods
       and procedures. Prerequisite: Spch. 295.

498.   INDEPENDENT RESEARCH. 4 TO 8 HOURS. May be repeated for credit up to
       a maximum of 8 hours. Department-approved research projects not included in
       thesis research. Prerequisite: Consent of the head of the department.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit up to a
       maximum of 16 hours. Students registering for thesis research will register under
       this number. Prerequisite: Consent of the head of the department.

URBAN PLANNING AND POLICY

Andrew L. Bavas, Director

Professors: Harry M. Scoble (Visiting), Edwin N. Thomas, Bernard
Weissbourd (Adjunct)

Associate Professors: Lenora Cartright, Michael B. Goldstein (Adjunct), Edward M. Levin (Adjunct), Stuart Schar, Ashish K. Sen

Assistant Professors: James N. Alexander, Calvin P. Bradford, Pierre R. de Vise (Visiting), Clarke H.P. Schneider, April L. Young

The College of Urban Sciences offers a seven-quarter program of professional study leading to the Master of Arts in Urban Planning and Policy. The broad goals of the program are those of the College of Urban Sciences: to educate its students to be capable of attacking contemporary urban problems; to provide multidisciplinary interaction among faculty, students, and members of the community; and to promote problem-relevant research.

The specific objectives are: (1) to train professional planners who will have the general knowledge and skills required to facilitate more comprehensive planning practice and sound management, with special emphasis on allocative and administrative skills; (2) to provide specialized training in four major interrelated fields of urban planning; (3) to encourage research toward the development of new knowledge in the field of urban planning and policy; and (4) to establish an accessible University-based resource for information and evaluation of community efforts directed toward resolving critical urban problems.

Students in the program may elect to specialize in any of four areas as their interest and need indicate: (1) urban planning and policy; (2) health services planning; (3) education planning; and (4) community development planning (the emphasis is on social planning, community development, and social policy development). Regardless of the area selected, the structure of the overall program is such that the interrelatedness of the problems and needs in each area can be clearly recognized and considered.

The program is divided into four elements:

Core

The work of the first two quarters of the academic year will consist of the core, which is designed to provide the student with a basic understanding of contemporary urban policy and planning problems, urban history, urban social organization, and analytical and management skills.

Specialization

During the third, fourth, and fifth quarters the student will select and pursue specialized in-depth study in one of the following four areas: (1) urban planning and policy, (2) community development planning, (3) health services planning, or (4) education planning.

Omnibus

During the sixth quarter, the student will participate in an intensive multidisciplinary research seminar that emphasizes creative and qualitative synthesis of information pertinent to one or more contemporary urban problems selected by the students in the seminar, in consultation with the faculty. The intent is to provide a laboratory in which students can pool their skills and apply them to an actual planning problem.

Field Work

During the seventh and final quarter most students will be expected to complete ten weeks of professional planning experience. However, this requirement will be waived for students with appropriate previous experience.

Admission Requirements

Generally, prospective students should have the ability to think and write creatively and should demonstrate the potential to identify, define, and formulate alternative solutions to problems by using appropriate methods. Further, the student should demonstrate a basic awareness of critical urban problems and issues.

Specifically, the applicant must hold a baccalaureate from an accredited college or university and must have maintained a cumulative grade-point average in the last 90 quarter hours (60 semester hours) of no less than 4.00 (A=5.00).

In addition to a completed Graduate College Application, each applicant must submit:

1. A succinct statement describing his/her educational and career goals, previous pertinent work, and volunteer and/or academic experience.
2. Three letters of recommendation if they have not been submitted in support of his/her application for a graduate appointment, such as a fellowship, an assistantship, or a tuition-and-fee waiver.
3. A recent paper, essay, or project of which the applicant is the sole author or designer. This material may be of an academic, professional, or personal nature. If the document is in written form, it should be at least 1000 words in length. It may be an extract from a larger work.

Degree Requirements

The student will be required to complete 84 quarter hours, the equivalent of seven quarters of full-time graduate level study. The curriculum is so designed that the student may complete it in seven consecutive quarters.

A student with demonstrated proficiency and prior professional

experience may petition for exemption from one or two quarters of applied professional practice, which would enable him/her to complete the program in fewer than seven quarters.

A grade point average of 4.00 is required for the degree. The Graduate College residency requirement of 24 quarter hours in regularly scheduled courses taken within one calendar year must also be met.

A thesis or successful completion of a comprehensive study project equal in rigorousness to a thesis is a further requirement.

One quarter of work in a professional planning experience. This requirement will be waived for a student with appropriate previous planning experience.

Focus of Specializations

Examples of the subject matter that will be presented in the four specializations follow:

Urban Policy Planning

Model Building and Program Strategy: Various models used to represent aspects of the urban complex, urban subsystems, and urban processes will be studied and tested.

Public Investment Planning: Methods and criteria for formulating long-range programs of public investment, capital budgeting, cost-benefit analysis, and social discounting.

Regional Analysis and Projection: Techniques of regional analysis, including those used for making forecasts of demographic and economic variables, will be emphasized.

The Housing Environment: The several dimensions of the housing environment, such as housing as a cultural artifact, as a consumer product in an industrial society, as a social good in a humane society, and as an architectural problem, to achieve aesthetic quality and livability relative to density and to supporting community facilities.

Regional Resource Planning: Review and critical analysis of outstanding examples of planning studies developed for large regions, with stress on the complex interactions among physical, demographic, and economic resources.

Community Development

Community Development: Theory and practice of organizing and planning with locality or community-based groups. The wide variety of models for organizing community groups is analyzed and evaluated.

Social Planning: A range of approaches to social planning, with special emphasis on their use in the development and implementation of human-service delivery.

Land Use Planning: Theory and practice of basic physical planning principles on both neighborhood and community scales. The relationship of physical planning to environmental quality will be stressed.

Community Problem Solving Analysis: Theories and practice of community development and planning are examined for use in developing models for problem solving, with treatment and comparisons of all levels of intervention and policy development.

Social Welfare Policies and Services: Value analysis of social welfare policy, issues, and programs; the evolution of social welfare programs, legislation, and current proposed reforms; and the politics of the process of social welfare policy formulation.

Educational Policy

Problems in Educational Policy Studies: The sociological and psychological factors governing educational policy development. Interaction among students, teachers, administrators with regard to institutional and community values. An examination of local and national extra-school organizations that shape learning. The balance between school and society in the socialization process will also be studied.

Alternative Educational Systems: Learning arrangements that may be alternatives to traditional schools and colleges, e.g., voucher systems, contracting-out plans, payments to employers to provide learning experiences to youths. The circumstances that stimulate such alternatives, their historic precedents, and their present and future prospects.

Educational Finance and Policy: Current and past arrangements for financing formal education at all levels. Role of local, state, and federal government, citizens and private organizations. Developing trends and their implications.

Educational Policy and Minorities: Past and current developments affecting school policies relating to minority children, e.g., de jure and de facto segregation, desegretation, compensatory education, community control. Role of local, state, and federal agencies and community groups. Relevant research and its implications.

Health Planning

Economics of Health Care: Principles of economic theory as applied to health. Supply/demand, cost-benefit analysis, manpower and resource allocation, and others.

Structure of Health Services: Institutional structures of public and private medicine: federal, voluntary, and private systems of health care delivery. Insurance programs and third-party payment. Correlated field experience in private and public hospitals.

Health Statistics: Biostatistics and descriptive statistics. Population and disease rates, ratios, age adjustment.

Health Law: Federal, state, and municipal laws bearing on the health of the population; the regulation of health-care providers and institutions; health planning, regulatory agency powers, and other pertinent activities.

Planning, Implementation, and Evaluation of Community Health Programs: Application of general planning and evaluation procedures to health programs. Correlated field study evaluation of an existing health facility or program.

Courses for Graduate and Advanced Undergraduate Students

380. QUANTITATIVE SKILLS AND ANALYTICAL TOOLS I. 4 HOURS. Fundamental mathematical concepts, calculus, matrices, and probability. Research techniques, computer manipulation and storage of data. Estimation, regression, and correlation. Prerequisite: Consent of the instructor.

381. QUANTITATIVE SKILLS AND ANALYTICAL TOOLS II. 4 HOURS. Survey of operations research techniques with urban applications. Introduction to a computer language. Urban information systems. Prerequisite: UPP 380.

382. MANAGEMENT AND ADMINISTRATIVE SKILLS I. 4 HOURS. Provides the student with fundamental but sound knowledge and understanding of (1) key administrative and managerial skills essential for urban policy makers and planners, (2) organization behavior, and (3) decision making in the political environment. Prerequisite: Consent of the instructor.

383. MANAGEMENT AND ADMINISTRATIVE SKILLS II. 4 HOURS. Continues Urban Planning and Policy 382. Relation and integration of operations, systems, and accounting methods to the decision-making process. Prerequisites: UPP 382 and consent of the instructor.

384. HISTORY AND THEORY OF URBAN PLANNING AND POLICY. 4 HOURS. Study and analysis of those planning theories, policies, and methods that have

evolved in response to the need for physical and human services planning in the urban community. Prerequisite: Consent of the instructor.

385.   HISTORY AND PROBLEMS OF URBAN SOCIETY I. 4 HOURS. The evolution of cities into urban complexes; emphasis on the various city-forming forces. Special attention to the benefits and problems stemming from the process of urbanization. Prerequisite: Consent of the instructor.

386.   HISTORY AND PROBLEMS OF URBAN SOCIETY II. 4 HOURS. Continues Urban Planning and Policy 385. Focus is on specific as opposed to general topics. Prerequisites: UPP 385 and consent of the instructor.

387.   COMMUNITY STUDIES. 4 HOURS. Study and analysis of changing models of socialization, the community in the larger context, and principles of community organization. The sociology and anthropology of diverse populations in the city and in the suburbs are considered. Prerequisite: Consent of the instructor.

Additional Courses for Graduate Credit

ACCOUNTING

Courses for Graduate and Advanced Undergraduate Students

300. MANAGERIAL COST ACCOUNTING. 4 HOURS. Analysis of costs for control, decision making, and planning; standards and budgets as a guide to measuring operating performance. Prerequisite: Actg. 302.

301. ASSET VALUATION AND INCOME DETERMINATION. 4 HOURS. The development, applications, and limitations of accounting theory as related to the valuation of assets and measurements of income. Prerequisite: Actg. 102.

302. ACCOUNTING FOR ENTITY INTEREST. 4 HOURS. Accounting for rights of creditors, stockholders, and partners in a going concern; effects of expansion and contraction on equities; basic principles of fiduciary and fund accounting. Prerequisite: Actg. 301.

303. AUDITING. 4 HOURS. The history, function, and theory of auditing; nature of the necessary evidence for the accountant's professional opinion concerning financial position and the results of enterprise operations; applications of statistical sampling; auditing computerized systems. Prerequisite: Actg. 302.

304. FEDERAL INCOME TAX. 4 HOURS. Concepts of federal income tax; its effects on decisions of corporations, partnerships, individuals, and trusts. Prerequisite: Actg. 300.

305. PLANNING AND CONTROL. 4 HOURS. The budget as a formal plan of action; the effect of decision making, forecasting, and uncertainty on the determination of enterprise goals; guidance techniques for the accomplishment of the planned objectives of a firm. Prerequisite: Actg. 300.

306. READINGS AND ADVANCED PROBLEMS. 4 HOURS. Consolidated statements, foreign subsidiaries, insurance, estates, theory, general statements. Prerequisite: Actg. 302.

307. FEDERAL INCOME TAX—ADVANCED. 4 HOURS. Advanced development of the basic concepts discussed in Accounting 304. Tax factors affecting business decisions of corporations, partnerships, estates, and trusts; special problems in reorganizations, liquidations, and personal holding companies; the federal estate tax and gift tax. Prerequisites: Senior standing and Actg. 304.

Courses for Graduate Students

400. MANAGERIAL ACCOUNTING I. 4 HOURS. Basic concepts and tools of analysis necessary for the quantification, recording, and communication of financial events.

401. MANAGERIAL ACCOUNTING II. 4 HOURS. Accounting methods applicable to the determination and analysis of financial data relevant to managerial decision problems. Topics include cost behavior, budgeting for planning and control, cost allocation, cost accounting systems, and capital budgeting. Prerequisite: Actg. 400.

402. FINANCIAL ACCOUNTING I. 4 HOURS. Formulation of a conceptual model of accounting valuation and its implications for accounting practice; accounting valuation methods applied to assets and equities and their relationship to the conceptual model; concepts and criteria underlying income determination. Prerequisite: Actg. 401.

403. FINANCIAL ACCOUNTING II. 4 HOURS. Accounting procedures applicable to the formation, expansion, and dissolution of different business entities, such as partnerships, corporations, trusts, and estates; emphasis on accounting for the corporate entity. Prerequisite: Actg. 402.

406. FINANCIAL PLANNING AND CONTROL. 4 HOURS. The uses of financial information for decision making and control; the role of the accounting system and corporate controller in developing and refining the data necessary for cost control and managerial planning. Prerequisite: Actg. 401.

ARCHITECTURE

Courses for Graduate and Advanced Undergraduate Students

301. ARCHITECTURAL DESIGN VII. 6 HOURS. Comprehensive architectural problems. Prerequisite: Arch. 204.

302. ARCHITECTURAL DESIGN VIII. 6 HOURS. Comprehensive architectural design problems. Prerequisite: Arch. 301.

309. ARCHITECTURAL DESIGN THESIS. 6, 9, OR 12 HOURS. May be repeated for a total of 18 hours. Individual problems in architectural design. Prerequisite: Arch. 301.

311. FORENSIC ARCHITECTURE. 3 HOURS. Legal problems in architecture. Prerequisite: Fifth year standing.

312. COMPUTER APPLICATIONS IN ARCHITECTURE. 3 HOURS. The use of electronic computers in building design and construction. Prerequisite: Math. 194 or 195.

313. BUILDING CONSTRUCTION SYSTEMS. 6 HOURS. Static and dynamic environmental control systems. Prerequisites: Arch. 204 and 215.

314. INDUSTRIALIZED BUILDING. 3 HOURS. Prefabrication of building components. Prerequisite: Fifth year standing.

315. LOGISTICS OF BUILDING CONSTRUCTION. 3 HOURS. Problems encountered in the logistics of building construction. Prerequisite: Fifth year standing.

316. ENVIRONMENTAL CONTROL SYSTEMS. 6 HOURS. Problems of color, illumination, heating and air conditioning systems, and acoustics. Prerequisite: Arch. 313.

319. BUILDING TECHNOLOGY THESIS. 6, 9, OR 12 HOURS. May be repeated for a total of 18 hours. Individual problems in building technology. Prerequisite: Arch. 313.

322. STRUCTURAL SEMINAR. 3 HOURS. May be repeated for credit. Selected topics in structural analysis and design. Prerequisites: Completion of 200-level structural engineering courses and Math. 220.

323. INTERMEDIATE STRUCTURAL ANALYSIS. 6 HOURS. The analysis of statically indeterminate coplanar and space structures. Prerequisites: Completion of 200-level structural engineering courses and Math. 220.

331. ARCHITECTURE SEMINAR. 1 TO 5 HOURS. May be repeated for a total of 15 hours. Current problems in architecture. Prerequisite: Fourth year standing.

332. ARCHITECTURE READING COURSE. 1 TO 5 HOURS. May be repeated for a total of 15 hours. Individually planned readings on selected topics under supervision of a faculty member. Prior to registration the student should be advised by the instructor. Prerequisite: Fourth year standing.

339. ARCHITECTURAL HUMANITIES THESIS. 12 HOURS. Individual problems in the architectural humanities. Prerequisite: 21 hours in the history of architecture.

343. PROFESSIONAL PRACTICE. 3 HOURS. Problems related to the practice of architecture. Prerequisite: Fifth year standing.

399. INDIVIDUAL STUDY: SPECIAL TOPICS III. 1 TO 6 HOURS. May be repeated for credit for a maximum of 18 hours. Selected topics in architecture for individual investigation. Prerequisite: Consent of the instructor.

ART-DESIGN

Courses for Graduate and Advanced Undergraduate Students

300. ART AND DESIGN SYNTHESIS. 4 HOURS. May be repeated for credit. Individual-project course. Students develop projects that synthesize the experience of 200-level courses in the Department of Art. Emphasis is on interdisciplinary activities. Prerequisites: 40 hours of 200-level courses in the Department of Art and approval of the department.

301. INDEPENDENT STUDY. 4 TO 12 HOURS. Student may enroll in more than one 4-hour section per quarter or may repeat the course in 4-hour sections in

subsequent quarters. Independent study under supervision of a staff member in an area of design or plastic and graphic arts not covered in the regular curriculum. The course is offered at the request of the student and only at the discretion of the staff members concerned. Prerequisites: 30 hours of 200-level courses and approval of the department.

303.   PHOTOGRAPHY-FILM TUTORIAL. 4 TO 6 HOURS. Students may enroll in more than one 4-hour section per quarter or may repeat the course in 4-hour sections in subsequent quarters. Independent study course. Sustained projects in any area of film activity or still photography. Prerequisites: AD 265 or 275 or graduate standing and approval of the department.

305.   PLASTIC AND GRAPHIC ARTS. 4 TO 16 HOURS. Students may enroll in more than one 4-hour section per quarter or may repeat the course in 4-hour sections in subsequent quarters. Individual projects in the plastic and graphic arts area are developed by each student through tutorial consultation with an assigned instructor; may involve supportive consultation in all areas of the department to permit breadth and invention in media and processes. Prerequisites: 25 hours of appropriate 200-level courses and approval of the department.

308.   COMPUTER ART-DESIGN. 4 HOURS. A practical exploration into the computer as a tool for the artist-designer. Prerequisites: Senior or graduate standing and Math. 194 or the equivalent.

309.   TEKART. 4 HOURS. Exploration into technological art; emphasis on group projects leading to exhibition or event. Prerequisites: Senior or graduate standing and AD 308 or 208.

310.   COMMUNICATIONS DESIGN. 4 TO 16 HOURS. Students may enroll in more than one 4-hour section per quarter or may repeat the course in 4-hour sections in subsequent quarters. A comprehensive project in the area of social communications. A total program or a series of related units for use in one or more communications media is developed by each student through tutorial consultation with an assigned instructor. Prerequisites: AD 215 or graduate standing and approval of the department.

320.   INDUSTRIAL DESIGN. 4 TO 16 HOURS. Student may enroll in more than one 4-hour section per quarter or may repeat the course in 4-hour sections in subsequent quarters. Design of physical systems based upon user behavior, technical resources, and environmental factors. Investigation of system failures and product dysfunctions at the man/machine, work space, and environmental levels. Projects are developed by the student through tutorial consultation with an assigned instructor. Prerequisites: AD 225 or graduate standing and approval of the department.

BLACK STUDIES

Courses for Graduate and Advanced Undergraduate Students

306.   GHETTO POLITICS. 4 HOURS. Same as Political Science 306. Analysis of the political impact of the ghetto on local, state, and national political systems; the

impotency of the ghetto voter; the ghetto politician; ghetto riots as political protest; the ghetto and presidential politics. Prerequisite: Three courses in political science, American history, or sociology.

370. TOPICS IN BLACK CULTURE. 4 HOURS. Seminar on various topics. Prerequisite: BlSt. 171.

379. INTRODUCTION TO AFRO-FRENCH LITERATURE. 4 HOURS. Same as French 379. Selected prose and poetry of sub-Sahara African Francophone literature. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

386. TOPICS IN RACE, ETHNIC, AND MINORITY HISTORY. 4 HOURS. May be repeated for credit. Same as History 386. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

BUSINESS LAW

Courses for Graduate and Advanced Undergraduate Students

310. MANAGERIAL JURISPRUDENCE. 4 HOURS. Application of the legal function to business administration. Basic legal tools for business transactions and corporate operations; legal aspects of the major segments of business management. Prerequisite: Junior standing.

CLASSICS

Courses for Graduate and Advanced Undergraduate Students

348. MYTHOLOGY IN ROME. 4 HOURS. Same as Religious Studies 300. The conscious assimilation and adaptation of Greek myth in Rome; investigation of the concept of myth. Prerequisite: Cl. 248.

349. CLASSICAL RHETORICAL TRADITION. 4 HOURS. Development of rhetorical tradition from its beginnings in ancient Greece to the Renaissance. Chief emphasis on the rhetorical works of Plato, Aristotle, Cicero, and Quintilian. Prerequisites: Junior standing and consent of the instructor.

350. AESCHYLUS AND SOPHOCLES. 4 HOURS. Knowledge of Greek is not required. Close reading of all of the plays of Aeschylus and Sophocles in translation; discussion of literary, moral, religious, political, and mythical issues and ideas. Prerequisite: Cl. 249.

351. EURIPIDES. 4 HOURS. Knowledge of Greek is not required. Close study of the works of Euripides, the environment in which they were created, and their influence on later European drama. Prerequisite: Cl. 249.

370. PLATO: *DIALOGUES*. 4 HOURS. The middle and late *Dialogues* and their fourteenth-century context.

393.   TRANSLATION: THEORY AND PRACTICE. 4 HOURS. A reading knowledge of Greek or Latin is expected. Introduction to classical and post-Renaissance concepts of fidelity and creativity; a practicum devoted to authors previously emphasized in the student's curriculum. Prerequisite: Consent of the instructor.

398.   TOPICS IN CLASSICAL CIVILIZATION. 4 HOURS. Knowledge of Greek or Latin is not required. Significant themes and topics in classical literature and society. Topics vary. Prerequisite: Two courses in classics at the 200 level, excluding Cl. 201.

DOCTOR OF ARTS

Courses for Graduate Students

402.   PSYCHOSOCIOLOGICAL FACTORS IN POST-SECONDARY INSTRUCTION. 4 HOURS. Psychological and sociological factors influencing the organization, the curriculum, and the instructional design of post-secondary educational institutions. Topics include psychological and sociological concepts affecting curriculum and instruction and the role of the disciplines in directing curriculum and instructional decisions.

404.   INSTRUCTIONAL DESIGN. 4 HOURS. Development of principles and practice of course development for graduate students who intend to teach and/or create course materials. Topics include: match between subject and student characteristics, use of different instructional approaches, use of different media and the integration of educational technology, role of tests, integration of elements.

406.   INSTRUCTIONAL TECHNOLOGY. 4 HOURS. Training and laboratory work in computer-assisted instruction and audio-visual instructional materials. Consideration of costs involved and problems of integrating instructional technology into the system in appropriate ways. Specific assignments relevant to the student's major disciplinary area.

408.   RESEARCH METHODS IN NATURAL EDUCATIONAL SETTINGS. 4 HOURS. Recording, documenting, analyzing, and reporting evidence of natural events related to education. Statistical design and inferential concepts and techniques. Methods for evaluation of instructional systems, materials, techniques, students, and teachers. Relation of research to planning and implementing change.

EDUCATION

Courses for Graduate and Advanced Undergraduate Students

301.   EDUCATIONAL POLICY IN URBAN AMERICA. 4 HOURS. Same as Political Science 301. Examination of selected urban phenomena in relation to educational bureaucracies and school socialization processes. Emphasis on: historical investigation of strategies for protest and change employed by ghetto populations;

conditions that fostered these strategies; responses of schools and other target institutions; social-philosophical analysis of ideologies supporting both protest and response. Prerequisites: One course in the social foundations of education or the equivalent and consent of the instructor.

302. PHILOSOPHY OF EDUCATION AND URBAN SCHOOL POLICY. 4 HOURS. Systematic exploration of selected educational theories and philosophies; particular emphasis on their impact on the problems of formulating urban educational policy. Areas of special concern: serving pluralistic interests, curriculum design, school organization, and school control. Prerequisite: One course in the foundations of education or the equivalent.

303. POLICY ISSUES IN THE HISTORY OF AMERICAN EDUCATION. 4 HOURS. A topical analysis of political, economic, and cultural influences shaping the development of American education policy; primary attention to issues of education theory and practice in their historical settings. Prerequisite: Ed. 170 or the equivalent.

304. PRACTICUM IN EARLY CHILDHOOD EDUCATION. 4 HOURS. Field placement in a child development center under the supervision of an approved qualified teacher. Experience in planning activities, evaluating the developmental progress of the children, and methods of child management. Weekly seminars to discuss the work. Prerequisite: Ed. 210 or 250 or Psch. 220.

305. EDUCATIONAL POLICY FOR CITIZENS. 4 HOURS. Same as Social Work 305. The concepts and information that all citizens need to participate effectively as education consumers and policy affectors. History, economics, basic statistics, sociology, research, and current and future trends affecting American education at all levels. Prerequisite: Consent of the instructor.

310. LEARNING BEHAVIOR PROBLEMS IN SCHOOL: DETECTION AND PROGRAM PLANNING. 4 HOURS. Development and organization of special education programs for children who have learning disabilities, emotional and behavior disorders, are educationally mentally retarded, or have impaired hearing. Screening techniques, referral processes, educational objectives, and program structure. Prerequisite: Ed. 321.

311. LEARNING AND LANGUAGE DISORDERS AND THE EXCEPTIONAL CHILD. 4 HOURS. Principal theories of learning and language disorders, language development, remediation of learning and language deficiencies, and the utilization of various communication techniques in the remedial education process. Prerequisites: Acceptance in advanced-level special education courses and consent of the instructor.

317. LANGUAGE CONCEPTS FOR THE HEARING IMPAIRED INTERMEDIATE AND SECONDARY STUDENT. 5 HOURS. Theoretical and educational aspects of language and language concepts utilized at the intermediate and high school levels. Prerequisite: Consent of the instructor.

320. SOCIAL DEVELOPMENT OF URBAN CHILDREN. 4 HOURS. A basic course that covers the general principles of social learning and socialization during

childhood and the factors common to urban children that illustrate and modify these principles. Classroom observation of children and interviewing are required. Prerequisite: Psch. 220 or the equivalent by consent of the instructor.

321.   ADVANCED EDUCATIONAL PSYCHOLOGY. 4 HOURS. Examination of psychological theories and principles of learning as they apply to the teaching-learning process; particular attention to the investigation of central concepts of the psychology of learning in the urban classroom. Prerequisites: Ed. 210 and 250 or the equivalents and consent of the instructor.

322.   ADVANCED DEVELOPMENTAL PSYCHOLOGY AND EDUCATIONAL PROCESSES. 4 HOURS. Normal growth stages in language, physical growth, cognitive development, and social behavior from birth through adolescence; their relationship to major theories and to educational planning and practice. Prerequisite: Ed. 321.

323.   CURRICULUM IN EARLY CHILDHOOD EDUCATION. 4 HOURS. Educational implications of major schools of thought concerning the nature and course of child development and learning; differential effectiveness of programs oriented to various theories; special emphasis on intervention programs designed for impoverished populations, including Head Start. Prerequisites: Psch. 101 and 220 or the equivalents and consent of the instructor.

324.   DIFFERENTIAL DIAGNOSIS OF LEARNING AND BEHAVIOR PROBLEMS. 4 HOURS. Characteristics of children with learning and behavioral problems. Theoretical basis for diagnosis and remediation of learning and behavior disorders. Prerequisite: Ed. 325.

325.   BEHAVIORAL MANAGEMENT THEORY AND TECHNIQUE. 4 HOURS. Utilization of behavior modification training and applied techniques in classroom management in the education of children with learning and behavior difficulties.

326.   PRESCRIPTIVE AND REMEDIAL TEACHING IN SPECIAL EDUCATION. 4 HOURS. Various techniques for the remediation of learning and behavioral problems; application of these methods to a wide variety of school learning and behavior problems. Demonstration by students of ability to assess and plan successful remedial programs for individual children. Prerequisite: Permission to take graduate-level courses in special education.

327.   ART MEDIA AND THEIR UTILIZATION WITH THE HANDICAPPED CHILD. 4 HOURS. Theoretical basis for utilization of art media with the handicapped. Student demonstrations of specific art media competencies in an applied setting with handicapped children. Prerequisites: Ed. 324, 326.

328.   PERCEPTUAL MOTOR EDUCATION AND THE HANDICAPPED CHILD. 4 HOURS. The interaction between the exceptional child's learning abilities and his perceptual motor development and skills. Seminar; demonstration of specific physical education and recreation competencies by the students. Prerequisites: Ed. 324 and 326.

329. INTRODUCTION TO THE THEORY OF JEAN PIAGET. 4 HOURS. Jean Piaget's genetic theory of the development of knowledge. Emphasis on his studies of cognitive development in children, especially his views on memory, learning, and intelligence. Consideration of educational implications. Prerequisites: Psch. 101, 220.

330. CURRICULUM, INSTRUCTION, AND EVALUATION IN URBAN EDUCATION I. 4 HOURS. A laboratory-discussion course; emphasizes the changing role of education in urban society and the implications of changes on curriculum decision making, design, instruction, and evaluation. Prerequisites: Ed. 250 or graduate standing and consent of the instructor.

331. IMPROVING LEARNING ENVIRONMENTS. 4 HOURS. Development of the basic skills and the understanding necessary to bring about productive changes in a school system; the skills are developed in conjunction with a plan for improving a specific learning environment. The consequences of change in the school as a social system. Prerequisites: One methods course or graduate standing and consent of the instructor.

332. ISSUES IN SECONDARY CURRICULUM. 4 HOURS. Analysis of selected issues; investigation of viewpoints in related literature; field investigations when pertinent. Specialists are invited. Prerequisite: Ed. 230 or a methods course offered in the student's major department or graduate standing.

360. DIFFERENTIATED READING INSTRUCTION. 4 HOURS. Students acquire competency in the teaching of individualized reading, remedial reading, and reading advancement programs through supervised field experience and seminar discussions. Prerequisites: Ed. 262 or 265 and consent of the instructor.

370. FIELD WORK FOR URBAN EDUCATION. 8 HOURS. Time is shared between field work and classroom to enable students to become intimately aware of some aspects of city life as it affects children and education. The different work sections are: (1) workers in a black community; (2) workers in a Latin or Indian community; (3) workers in a selected white ethnic community; (4) school administrators and counselors; (5) workers in human relations areas. Prerequisites: Ed. 250 or graduate standing and consent of the instructor.

371. COMMUNITY EDUCATION LABORATORIES. 5 HOURS. 3 hours class time; 10 to 14 hours per week in directed field work. Analysis of the colonialist nature of the educational enterprise and of the relationships among the educational controllers, the teacher, and the community, through reading, lecture, discussion, and field work. Consideration of techniques for altering professional accountability of teachers from the employing community to those people they purport to help: students and community. Prerequisite: Consent of the instructor.

383. TEACHING ENGLISH AS A SECOND LANGUAGE. 4 HOURS. Same as English 383. The methodology of teaching English to residents of the United States who do not speak the language, especially Spanish-Americans. Prerequisite: Engl. 300 or 205 or Ling. 305.

390.   CRITIQUE OF EDUCATIONAL LITERATURE, RESEARCH DESIGN, AND
        METHODOLOGY. 4 HOURS. Introduction to educational research literature;
        analysis of research findings in urban education; research methods and design in
        education; current issues in research methodology. Each student formulates a
        researchable problem and designs a systematic study in his area of concentration.
        Prerequisites: Ed. 250 or graduate standing and consent of the instructor.

Courses for Graduate Students

400.   SEMINAR ON EDUCATIONAL SOCIOLOGY. 4 HOURS. Sociological survey of
        the urban educational institution in the contexts of its neighborhood and of the
        larger social order. The school is considered a community with its own social
        structure and culture interacting with a neighborhood with a differing social
        structure and culture. The interface between school and neighborhood is studied
        in detail. Prerequisites: Ed. 370 or the equivalent and consent of the instructor.

425.   RESEARCH AND EVALUATION IN SPECIAL EDUCATION. 4 HOURS.
        Analysis of basic research issues; the theoretical models for evaluating a
        noncategorical, competency-based approach to the education of the exceptional
        child. Prerequisites: Acceptance in advanced-level special education courses and
        consent of the instructor.

426.   BIOLOGICAL, COGNITIVE, AND SOCIAL DEVELOPMENT IN INFANCY
        AND EARLY CHILDHOOD. 4 HOURS. Intensive consideration of
        developmental processes, capacities, and readiness from birth to the age of six
        years. Stress is on theories, research, individual child study, and educational
        implications. Prerequisite: Ed. 322.

427.   CLINICAL EXPERIENCE IN REMEDIAL TEACHING. 4 HOURS.
        Demonstrations by students of the ability to diagnose, prescribe, and develop a
        remedial program. Utilization of educational clinic and field internship experience
        with handicapped children in an educational setting.

430.   CURRICULUM, INSTRUCTION, AND EVALUATION IN URBAN
        EDUCATION II. 4 HOURS. Emphasizes dynamics of group decision making in
        developing curricula for community schools, producing instructional materials for
        a selected community, and evaluating effectiveness of the instructional materials.
        The different work sections are: (1) black ghetto community; (2)
        Spanish-speaking community; (3) other selected communities. Prerequisites: Ed.
        330, 370, 490 or the equivalent and consent of the instructor.

431.   CURRICULUM THEORY AND TECHNOLOGY. 4 HOURS. Components of the
        curriculum system are analyzed through the study of curriculum theory. The
        technology of curriculum planning, implementing and evaluating local, state, and
        national curricula is explored. Prerequisites: Ed. 430 or the equivalent and
        consent of the instructor.

432.   RESOURCES AND METHODS FOR INSTRUCTIONAL IMPROVEMENT. 4
        HOURS. Offered in collaboration with the Chicago Board of Education staff to
        develop an understanding of available resources and methods for initiating

innovation plans for in-service instruction and program development. Emphasis on understanding the public school system and the ways in which its various components interact. Prerequisite: Ed. 331.

439. INTERNSHIP IN IN-SERVICE AND PRESERVICE LEADERSHIP. 8 HOURS. The internship is conducted in the school in which the candidate is employed. Working under the supervision of the school principal and a member of the University faculty, the intern supervises a group of student teachers and develops a plan for instructional improvement on a systematic basis. Prerequisite: Ed. 432.

440. GUIDANCE IN THE URBAN SCHOOL: PRINCIPLES AND FUNCTIONS. 4 HOURS. Examination of the guidance process concerned with providing for the developmental needs of all pupils. The interrelated roles of teacher, counselor, and other staff members in fostering a climate in which healthy personalities can develop; emphasis on the full use of school and community resources. Prerequisites: Ed. 370 and consent of the instructor.

441. STUDENT APPRAISAL PROCEDURES IN THE URBAN SCHOOL. 4 HOURS. Examination of some of the ways in which the teacher and counselor can assess child behavior and development. Nontesting methods and interpretation of selected achievement, aptitude, and interest tests at different educational levels. Emphasis on the understanding of cultural factors that may limit effective appraisal. Prerequisite: Ed. 440.

442. THE COUNSELING PROCESS. 4 HOURS. The nature, functions, and goals of counseling in an urban school or youth center. Selected theories, with applications for school and agency counseling, and related problems and issues. An introduction to counseling interaction is provided through role-playing and supervised interviews in which study skills and related educational problems are presented. Prerequisite: Ed. 441.

445. EDUCATIONAL EVALUATION DESIGN AND METHODS. 4 HOURS. A basic course in which theoretical and operational assumptions of different approaches to evaluation are examined. Students work with a range of practical problems in the use of evaluations in various educational settings and assess the advantages and constraints of evaluation data. Prerequisite: Ed. 390.

446. EDUCATIONAL MEASUREMENT. 4 HOURS. Design, analysis, and critique of cognitive, affective, and behavioral instruments and techniques for use in educational settings. Each student makes a critical analysis of a published test, constructs a pilot instrument, and performs an item analysis.

448. INTERNSHIP IN MEASUREMENT AND EVALUATION. 4 HOURS. Internship in the Office of Evaluation and Research, the College of Education. Area majors in measurement and evaluation become involved with evaluation projects in schools and governmental and social service agencies under the supervision of a project director. May be taken in one or two quarters.

449. INTERNSHIP IN COUNSELING URBAN YOUTH. 8 HOURS. Students are assigned to urban schools where they function as assistant counselors.

Responsibilities may include tutorial counseling, testing and test interpretation, conferences with staff members and parents, preparing educational and vocational materials, arranging occupational field trips, and developing working relations with community agencies and organizations. Prerequisite: Ed. 442.

450.   FOUNDATIONS OF SCHOOL ADMINISTRATION. 4 HOURS. Introductory course in urban school administration. Emphasis on the interdisciplinary study of both the theoretical and practical aspects of administration. Prerequisite: Consent of the instructor.

451.   ADMINISTRATION PROBLEMS IN URBAN SCHOOLS. 4 HOURS. The school as a social institution and its role in the solution of contemporary social problems. Emphasis on community-school relationship and its effect on school administrators. Prerequisite: Ed. 450.

459.   INTERNSHIP IN SCHOOL ADMINISTRATION. 8 HOURS. For students enrolled in the masters program in school administration. Students are placed in schools and community agencies to obtain practical knowledge of some of the community-school relationships studied in Education 450 and 451. Prerequisite: Ed. 451.

461.   BLACK DIALECT AND INSTRUCTIONAL METHODS. 4 HOURS. Contrastive analysis of black dialect and standard English. Specific topics include dialects, historical-social-cultural factors, the black idiom, interference, and methods of teaching standard English. Prerequisite: Ling. 305.

462.   TEACHING READING TO BLACK AND SPANISH-SPEAKING INNER-CITY STUDENTS. 4 HOURS. Examination of effective methods and materials. Particular emphasis on the interference of nonstandard language systems and/or Spanish. Section A: teaching black students; Section B: teaching Spanish-speaking students. Prerequisite: Ed. 461 or Ling. 305.

463.   ANALYSIS OF RESEARCH LITERATURE IN READING. 4 HOURS. Critical analysis of issues in reading and reading instruction with reference to research. A research project is developed. Prerequisites: An introductory statistics course or Ed. 390, Ed. 360 or the equivalent, and consent of the instructor.

490.   ETHNOGRAPHY OF URBAN EDUCATIONAL INSTITUTIONS. 4 HOURS. Ethnography of an urban educational institution and its interaction with clientele. Ethnographic and microethnographic techniques, including the use of tape recorder and film, are surveyed and practiced in a field study. Reading in cognitive anthropology, organization research, and urban ethnography accompanies the field work. Prerequisites: Ed. 400 or the equivalent and consent of the instructor.

495.   INTERNSHIP IN SPECIAL EDUCATION. 4 HOURS. Utilizes an educational clinic to develop specific diagnostic, prescriptive, and remedial educational skills in depth. For the second phase of internship, an urban school setting is utilized; students work under the direction of a master teacher, applying the theory and skills developed in the educational clinic. Prerequisite: Completion of the first three introductory courses at the Master of Arts level in special education.

497. INDIVIDUAL STUDY. 1 TO 6 HOURS. Students design, implement, and analyze results of a researchable problem in their individual area of concentration. Completed study is reviewed by faculty and peer committees. Prerequisites: Ed. 390 or the equivalent and consent of the instructor.

FINANCE

Courses for Graduate and Advanced Undergraduate Students

350. BUSINESS FINANCE. 4 HOURS. No credit for graduate students in the finance curriculum. Nature of business finance and its relation to economics, accounting, and law; legal nature and forms of business enterprise; capital, capitalization, and financial planning; financial analysis and interpretation; initial financing, refinancing; working capital; income administration, including dividend policies; expansion; internal and external financial and economic relationships of the firm. Prerequisites: Actg. 102 and Econ. 120.

351. INVESTMENTS. 4 HOURS. Types and distinguishing features of securities, security markets, analysis of financial statements and principles of valuation, quality differences, selection of securities to meet varying personal and institutional objectives. Prerequisites: Fin. 350 and 360. Business administration students must have declared a major.

352. INVESTMENT POLICY. 4 HOURS. Varying strategies to meet diverse objectives; investments for individuals, business firms, banks, insurance companies, pension and profit-sharing funds; interrelation of investment policies and the economic environment. Prerequisite: Fin. 351. Business administration students must have declared a major.

353. PROBLEMS IN BUSINESS FINANCE. 4 HOURS. Selected areas in advanced corporate finance, including short-term asset management; capital budgeting under certainty and uncertainty; capital structure and dividend policy and theory; valuation and risk; the structure of capital asset prices, and implications of that structure for financial policy of firms. Prerequisite: Fin. 350. Business administration students must have declared a major.

360. MONEY AND BANKING. 4 HOURS. Monetary and banking systems. The Federal Reserve System; monetary theory; international monetary relations; monetary policy in the United States. Prerequisite: Econ. 121. Business administration students must have declared a major.

399. INDEPENDENT STUDY IN FINANCE. 2 TO 4 HOURS. May be repeated for credit. For students in good standing. Prerequisites: 16 hours of upper-division credit in finance, consent of a faculty member and of the head of the department.

FRENCH

Courses for Graduate and Advanced Undergraduate Students

301. STYLISTICS I: PROSE. 4 HOURS. Detailed analysis of the style of selected

French authors; practice in advanced composition. Prerequisite: Fr. 222 or the equivalent.

302.   STYLISTICS II: POETRY. 4 HOURS. Detailed analysis of the style of selected French authors; practice in advanced composition. Prerequisite: Fr. 222 or the equivalent.

311.   SHORT PROSE FICTION. 4 HOURS. French prose narrative forms, excluding the novel, from the Renaissance to the present. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

316.   FRENCH POETRY I. 4 HOURS. Major poets from the fourteenth through the eighteenth centuries. Prerequisities: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

321.   FRENCH LITERATURE OF THE MIDDLE AGES I. 4 HOURS. From the origins to 1300. Texts in modern French: *chansons de geste,* courtly romances (Chrétien de Troyes et al.), *Roman de Renard,* and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

322.   FRENCH LITERATURE OF THE MIDDLE AGES II. 4 HOURS. The fourteenth and fifteenth centuries. Texts in modern French: chroniclers; lyric poetry; religious and comic drama. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

323.   HISTORY OF THE FRENCH LANGUAGE. 4 HOURS. From its origins to the present. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

332.   FRENCH LITERATURE OF THE SIXTEENTH CENTURY. 4 HOURS. Major writers to be read in modern French: Marot, Scève, Rabelais, Ronsard, Du Bellay, Montaigne, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

333.   THE *PLÉIADE.* 4 HOURS. Theory and practices of the *Pléiade* poets: Ronsard, Du Bellay, Belleau, Baïf, Jodelle, Pontus de Tyard, Desportes, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

334.   MONTAIGNE: HIS *ESSAIS* AND HIS AGE. 4 HOURS. Detailed study of Montaigne's life, thought, and times as reflected in the *Essais.* Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

341.   SEVENTEENTH CENTURY FRENCH PROSE WRITERS. 4 HOURS. Reading and analysis of major prose writers: Descartes, Pascal, Bossuet, Mme. de Sévigné, La Bruyère, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

342.   SEVENTEENTH CENTURY FRENCH THEATER. 4 HOURS. Reading and analysis of major dramatists: Corneille, Molière, and Racine. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

344. .SEVENTEENTH CENTURY FRENCH POETRY. 4 HOURS. Reading and analysis of major poets: Malherbe, Baroque poets, La Fontaine, and Boileau. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

345. THE SEVENTEENTH CENTURY FRENCH NOVEL. 4 HOURS. Reading and analysis of major novelists: d'Urfé, Sorel, Scarron, Cyrano, Mme. de Lafayette, *Les Lettres Portugaises,* and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

351. FRENCH LITERATURE OF THE EIGHTEENTH CENTURY I. 4 HOURS. Prose writers; reading and analysis of Lesage, Montesquieu, Diderot, Voltaire, Rousseau, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

352. FRENCH LITERATURE OF THE EIGHTEENTH CENTURY II. 4 HOURS. Reading and analysis of major dramatists: Crébillon, Voltaire, Marivaux, Diderot, Beaumarchais, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

353. LITERARY AND INTELLECTUAL CURRENTS OF THE EIGHTEENTH CENTURY. 4 HOURS. Reading and analysis of selected works tracing major literary and intellectual currents; Montesquieu, Voltaire, Rousseau, Diderot, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

354. THE FRENCH NOVEL OF THE EIGHTEENTH CENTURY. 4 HOURS. Reading and analysis of selected novels of Prévost, Crébillon *fils,* Voltaire, Diderot, Rousseau, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

359. PREROMANTICISM. 4 HOURS. The Preromantic movement in France from 1761 to 1814. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

360. *LA BATAILLE ROMANTIQUE.* 4 HOURS. Manifestos, polemical writings, and major literary productions of the period. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

361. FRENCH ROMANTICISM I. 4 HOURS. Reading and analysis of selected works tracing the main developments in the Romantic movement from 1815 to 1829; Hugo, Stendhal, Mérimée, Lamartine, Vigny, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

362. FRENCH ROMANTICISM II. 4 HOURS. Reading and analysis of selected works tracing the main developments of the Romantic movement after 1830; Nerval, Baudelaire, Sand, Musset, Hugo, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

363. THE FRENCH NOVEL OF THE NINETEENTH CENTURY I. 4 HOURS. Reading and analysis of major novelists: Chateaubriand, Senancour, Mme. de

Staël, Constant, Lamartine, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

364.   THE FRENCH NOVEL OF THE NINETEENTH CENTURY II. 4 HOURS. Reading and analysis of major novelists: Stendhal, Balzac, Mérimée, George Sand, Flaubert, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

365.   THE FRENCH NOVEL OF THE NINETEENTH CENTURY III. 4 HOURS. Reading and analysis of major novelists: the Goncourt brothers, Zola, Maupassant, Loti, France, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

366.   FRENCH POETRY II. 4 HOURS. Major poets of the nineteenth century; Lamartine, Hugo, Musset, Vigny, Gautier, Baudelaire, Verlaine, Rimbaud, Mallarmé, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

368.   MODERN FRENCH DRAMA I. 4 HOURS. Major dramatists of the nineteenth and twentieth centuries; Hugo, Vigny, Musset, Dumas *fils,* Augier, Becque, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

369.   MODERN FRENCH DRAMA II. 4 HOURS. Continues French 368. Curel, Porto-Riche, Rostand, Claudel, Lenormand, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

370.   MODERN FRENCH DRAMA III. 4 HOURS. Continues French 368 and 369. Cocteau, Giraudoux, Anouilh, Sartre, Camus, Beckett, Ionesco, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

371.   FRENCH POETRY III. 4 HOURS. Major poets of the twentieth century; Jammes, Jacob, Apollinaire, Valéry, Eluard, Breton, Aragon, Perse, Michaux, Prévert, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

372.   THE FRENCH NOVEL OF THE TWENTIETH CENTURY I. 4 HOURS. Reading and analysis of selected novels by Gide, Proust, Mauriac, Colette, Cocteau, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

373.   THE FRENCH NOVEL OF THE TWENTIETH CENTURY II. 4 HOURS. Reading and analysis of selected novels by Malraux, Aragon, Saint-Exupéry, Céline, Giraudoux, and others. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

374.   THE FRENCH NOVEL OF THE TWENTIETH CENTURY III. 4 HOURS. Reading and analysis of selected novels by Sartre, Camus, Robbe-Grillet, Sarraute, Butor, and other contemporary novelists. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

379. INTRODUCTION TO AFRO-FRENCH LITERATURE. 4 HOURS. Same as Black Studies 379. Selected prose and poetry of sub-Sahara African Francophone literature. Prerequisites: Fr. 201 and any two of Fr. 202, 203, 204, 205 or the equivalents.

381. INTRODUCTION TO LINGUISTICS. 4 HOURS. French phonology, morphology, syntax, and semantics in comparison with English. Prerequisites: Fr. 212, 222, 281 or the equivalents.

382. TEACHERS COURSE. 4 HOURS. Resources, classroom materials, standard practices, and problems in the teaching of French; practical application to actual classroom situations. Prerequisite: Fr. 381 or consent of the instructor.

390. PERSPECTIVES IN FRENCH LITERATURE. 4 HOURS. A synthesis of specialized knowledge previously acquired in various areas at the 300 level; a new perspective on French literature in its historical development, presented through representative works by major authors. Prerequisites: Senior standing, Fr. 201 and any two of Fr. 202, 203, 204, 205.

399. SEMINAR ON SELECTED TOPICS. 4 HOURS. May be repeated for credit. Specific movements, authors, or works. Topics are announced in the Timetable. Prerequisite: Senior standing and/or consent of the instructor.

Courses for Graduate Students

403. *EXPLICATION DE TEXTES.* 4 HOURS. Detailed critical and stylistic analysis of selected short pieces of French prose and poetry. Lectures, discussion, and student *explications.* Prerequisite: Fr. 301 or 302 or the equivalent.

404. MODERN FRENCH PHONETICS AND PHONOLOGY. 4 HOURS. One hour per week in the language laboratory. Phonetic description and transcription. Training in diction and interpretation of literary texts. Phonetics as a teaching device. Prerequisite: Fr. 301 or 302 or the equivalent.

405. THE TEACHING OF COLLEGE FRENCH. 0 HOURS. Required of all graduate teaching assistants. Problems of teaching French at the college level; classroom procedures, and the preparation and grading of tests and final examinations. Prerequisite: Teaching Assistant in French.

406. INTRODUCTION TO OLD FRENCH PHILOLOGY: I PHONOLOGY. 4 HOURS. Phonological development of the French language from classical and Vulgar Latin.

415. THE *LIBERTINS* IN THE SEVENTEENTH AND EIGHTEENTH CENTURIES. 4 HOURS. Intensive study of works not usually covered in courses on seventeenth and eighteenth century literature. Prerequisites: Fr. 341, 351 or the equivalents.

416. STRUCTURES OF FRENCH CULTURE. 4 HOURS. Introduction to the cultural structures that orient French business, government, and political activity: social class, the educational system, bureaucratic centralization, the Church.

427.   *ROMANTISME SOCIAL.* 4 HOURS. Development of Romantic thought after the Revolution of 1830. Social consciousness of Sand, Hugo, Lamartine, Musset, Vigny. Influence of Leroux and Lamennais.

430.   THE USE OF GREEK MYTHOLOGY IN THE CONTEMPORARY FRENCH THEATER. 4 HOURS. Greek tragic vision in the works of Cocteau, Giraudoux, and Anouilh. Prerequisites: Fr. 342 and 370 or the equivalents.

440.   SEMINAR FOR MASTER OF ARTS CANDIDATES. 4 HOURS. May be repeated for credit. Topics to be announced each quarter.

490.   INDEPENDENT STUDY FOR GRADUATE STUDENTS. 1 TO 8 HOURS. May be repeated for credit up to a maximum of 8 hours. Prerequisite: Consent of the head of the department.

499.   THESIS RESEARCH. 0 TO 16 HOURS. May be repeated for credit. Prerequisite: Approval of the department.

GREEK

Courses for Graduate and Advanced Undergraduate Students

305.   HOMER: *ILIAD.* 4 HOURS. Reading and translation of extensive selections from the poem. Introduction to Homeric scholarship. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

310.   PINDAR. 4 HOURS. Reading and analysis of selected *Odes.* Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

315.   AESCHYLUS: *AGAMEMNON.* 4 HOURS. Reading and analysis of the play; discussion of the use of myth. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

329.   GREEK SCIENCE. 4 HOURS. Individual conferences on assigned papers are required. Primarily for Greek majors. Examination and interpretation of selected texts illustrative of the classical development of Greek science from 500 B.C. Prerequisite: Any 200-level course in classical Greek.

330.   ARISTOPHANES. 4 HOURS. Reading and translation of at least two plays. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

340.   DEMOSTHENES. 4 HOURS. Reading and analysis of two or more speeches; study of their historical background. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

350.   PLUTARCH. 4 HOURS. Reading and interpretation of one or more of the *Moral Essays* or the *Lives.* Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

360. PLATO: *THE REPUBLIC*. 4 HOURS. Reading and interpretation of selections; analysis of style and thought, and the development of some of the major arguments. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

365. ARISTOTLE: *NICOMACHEAN ETHICS*. 4 HOURS. Same as Religious Studies 365. Reading and analysis of selections from several books. Sources and problems of Aristotle's ethical writings. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

370. THUCYDIDES. 4 HOURS. Reading and translation of selections from Thucydides' history of the Peloponnesian War. Sources and problems of Greek historiography. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

380. HELLENISTIC POETRY. 4 HOURS. Reading and analysis of selections from 350 B.C. to 350 A.D. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

381. GREEK LITERARY CRITICISM. 4 HOURS. Reading and translation of Aristotle's *Poetics* and selections from Longinus' *On the Sublime*. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

382. GREEK RHETORIC. 4 HOURS. Selected texts illustrative of the Greek contribution to the art of rhetoric; special attention to the *Rhetoric* of Aristotle. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

399. INDEPENDENT READING. 1 TO 4 HOURS. May be repeated for credit. For Greek majors and graduate students. Independent study under faculty direction. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

HISTORY OF ARCHITECTURE AND ART

Courses for Graduate and Advanced Undergraduate Students

311. THE ANCIENT CITY. 4 HOURS. The historical development of the city in the ancient Near East, Greece, and the Roman Empire. Prerequisite: Graduate standing in architecture or 8 hours in the history of architecture and art ancient sequence.

323. GOTHIC SCULPTURE. 4 HOURS. Development of sculpture in northern Europe from 1140 to 1530. Prerequisites: Junior standing and 4 hours of history of architecture and art at the 200 level.

325. SEMINAR ON MEDIEVAL ART. 4 HOURS. Individual conferences on assigned papers are required. Selected problems in the history of medieval art. Series of lectures followed by student reports. Prerequisites: Junior standing and 4 hours of HAA 200-level courses.

331.   SEMINAR ON THE HISTORY OF ARCHITECTURE. 4 HOURS. Selected problems. Prior to registration the student should be advised by the instructor. Prerequisite: 12 hours from HAA 231 through 238.

332.   READINGS IN THE HISTORY OF ARCHITECTURE. 4 HOURS. Individually planned readings on selected topics under the supervision of a faculty member. Prerequisites: 12 hours from HAA 231 through 238 and approval of the instructor and the department.

333.   LITERATURE, THEORY, AND CRITICISM. 4 HOURS. Selected readings and discussion of significant writers on architecture. Prerequisites: 12 hours from HAA 231 through 238 and approval of the instructor and the department.

334.   CHICAGO BUILDING. 4 HOURS. Architectural and technical history of Chicago's commercial buildings from 1871 to the present. Prerequisite: 12 hours from HAA 231 through 238.

335.   WRIGHT AND HIS CONTEMPORARIES, 1890 TO 1910. 4 HOURS. Frank Lloyd Wright's domestic buildings in the Chicago area and his relationship to other members of the "Prairie School" of midwest architecture. Lectures, discussions, and field trips. Prerequisite: 12 hours from HAA 231 through 238.

336.   SEMINAR: ADLER AND SULLIVAN. 4 HOURS. Critical study of Chicago's foremost architectural partnership: monuments, theories, and practice. Prerequisites: 12 hours from HAA 231 through 238 and HAA 334.

341.   ART OF THE FIFTEENTH CENTURY IN FLORENCE. 4 HOURS. Stylistic and iconographic studies of the works of the major painters, sculptors, and architects. Florentine history and literature in their relation to the visual arts. Prerequisites: Junior standing and 4 hours in history of architecture and art courses at the 200 level.

342.   ART OF THE HIGH RENAISSANCE. 4 HOURS. Art of the great Italian centers during the late fifteenth and early sixteenth centuries. Emphasis on Leonardo, Raphael, Bramante, Bellini, Giorgione, and Michelangelo. Prerequisites: Junior standing and 4 hours in history of architecture and art courses at the 200 level.

343.   ITALIAN ART FROM 1520 TO 1600. 4 HOURS. Art of the sixteenth century; emphasis on painting and sculpture. Special attention is given to Correggio, Pontormo, Bronzino, Gianbologna, Michelangelo, Palladio, Titian, and Tintoretto. Prerequisites: Junior standing and 4 hours in history of architecture and art courses at the 200 level.

361.   PROSEMINAR IN MODERN PAINTING. 4 HOURS. May be repeated for credit at the discretion of the department. Selected examples; development and diffusion of style and iconography. Analogies in the history of ideas and events, technical change, and other pertinent material. Prerequisites: Junior standing and 4 hours in history of architecture and art courses at the 200 level.

362.   PROSEMINAR IN MODERN SCULPTURE. 4 HOURS. May be repeated for credit at the discretion of the department. Selected examples; development and

diffusion of style and iconography. Analogies in the history of ideas and events, technical change, and other pertinent material. Prerequisites: Junior standing and 4 hours in history of architecture and art courses at the 200 level.

363. CONTEMPORARY ART. 4 HOURS. The most recent developments in contemporary art, its theories and production. Prerequisites: Junior standing and 4 hours in history of architecture and art courses at the 200 level.

371. CHINESE LANDSCAPE PAINTING. 4 HOURS. Chinese landscape painting from its origins to the twentieth century; major trends and figures. Prerequisite: HAA 271 or 12 hours in Asian studies.

372. JAPANESE PRINTS. 4 HOURS. History from the fourteenth century to the present; emphasis on Ukiyoe Hanga of the seventeenth to nineteenth centuries. Prerequisite: HAA 272 or the equivalent.

381. SEMINAR ON AMERICAN ART. 4 HOURS. Problems on American artists or movements selected with the permission of the instructor. Prerequisites: Junior standing and 12 hours of history of architecture and art at the 200 level.

385. SEMINAR: FILM ISSUES. 4 HOURS. Individual conferences on assigned papers are required. Studies in genres, schools, individual artists, critics, and theorists of the motion picture. Subject areas are specified by the instructor. Prerequisites: Junior standing and HAA 285, 286.

391. SPECIAL STUDIES IN HISTORY OF ART. 4 HOURS. May be repeated for a total of 12 hours. Discussions each quarter of special problems with attention to a major theme, period, or artist. Student reports are required. Prerequisites: Senior standing, 12 hours in history of architecture and art courses at the 200 and 300 levels, and approval of the instructor and the department.

392. READINGS IN ART HISTORY. 4 HOURS. May be repeated for credit at the discretion of the department. Individually planned readings on selected topics under supervision of a faculty member. Prerequisites: Senior standing, 12 hours in history of architecture and art courses beyond the 100 level, and approval of the instructor and the department.

393. HISTORY OF COLLECTING AND MUSEOLOGY. 4 HOURS. The history of collecting and patronage. The scope and operation of public and private collections and museums. Lectures, discussions, and field trips. Prerequisites: Junior standing and HAA 142, 143, 144.

HUMANITIES

Courses for Graduate and Advanced Undergraduate Students

319. *DON QUIJOTE.* 4 HOURS. Same as Spanish 319. Reading and discussion; emphasis on novelistic technique and development of the novel. Prerequisite: Span. 218.

ITALIAN

Courses for Graduate and Advanced Undergraduate Students

305. ITALIAN LITERARY MOVEMENTS TO 1450. 4 HOURS. Major developments in Italian literature to 1450. Prerequisite: Two 200-level courses in Italian.

306. ITALIAN LITERARY MOVEMENTS FROM 1450 TO 1600. 4 HOURS. Continues Italian 305. Prerequisite: Two 200-level courses in Italian.

307. ITALIAN LITERATURE FROM 1600 TO 1800. 4 HOURS. Continues Italian 306. Prerequisite: Two 200-level courses in Italian.

308. ITALIAN LITERATURE FROM 1800 TO THE PRESENT. 4 HOURS. Continues Italian 307. Prerequisite: Two 200-level courses in Italian.

399. INDEPENDENT STUDY. 1 TO 6 HOURS. May be repeated for credit. Independent research on various aspects of Italian culture and studies that are not covered in regular courses. Prerequisite: Consent of the instructor.

LATIN

Courses for Graduate and Advanced Undergraduate Students

301. *CORPUS CAESARIANUM.* 4 HOURS. For advanced undergraduates, graduates, secondary school teachers of Latin, and prospective teachers. Rapid reading of Latin prose, based on the *Corpus Caesarianum;* discussion of the linguistic, literary, social, and political aspects that contribute to the understanding of the texts read. Prerequisites: Junior or senior standing in Latin, at least one year of Latin beyond Lat. 106.

302. TIBULLUS AND PROPERTIUS. 4 HOURS. Reading and interpretation of selections from their chief elegiac poems. Prerequisite: 4 hours of Latin at the 200 level or the equivalent.

304. SENECA: PROSE WORKS. 4 HOURS. Reading of two or more of the *Moral Essays* and/or a selection of the *Letters.* Prerequisite: 4 hours of Latin at the 200 level or the equivalent.

305. SENECA: TRAGEDIES. 4 HOURS. Reading and interpretation of one or more of the tragedies. Prerequisite: 4 hours of Latin at the 200 level or the equivalent.

306. CICERO: PHILOSOPHIC ESSAYS II. 4 HOURS. Reading of two or more books from among *De Finibus, De Natura Deorum, De Divinatione, Academici;* study of related problems. Prerequisite: One 200-level course in Latin or the equivalent.

308. CICERO: LETTERS. 4 HOURS. Reading and translation of selections of the *Letters to Atticus* and the *Letters to His Friends.* Prerequisite: 8 hours of Latin at the 200 level or the equivalent.

309.   VERGIL: *Eclogues* and *Georgics*. 4 HOURS. Reading and analysis of selections from Vergil's earlier works. Prerequisite: 8 hours of Latin at the 200 level.

310.   PLAUTUS II. 4 HOURS. Advanced studies in Roman comedy and the reading of two or more plays not read in Latin 210. Prerequisite: At least 8 hours of Latin at the 200 level or the equivalent.

340.   LUCRETIUS. 4 HOURS. Reading and interpretation of extensive selections from *De Rerum Natura*. Prerequisite: 4 hours of Latin at the 200 level or the equivalent.

348.   ST. AUGUSTINE: *THE CONFESSIONS*. 4 HOURS. Same as Religious Studies 348. The autobiographical portions of *The Confessions*. Prerequisite: One 200-level course in Latin.

350.   MEDIEVAL LATIN. 4 HOURS. Literary and linguistic study of Latin texts originating between 350 and 1350 A.D. Prerequisites: Lat. 106 and 203 or the equivalents.

351.   OVID: ELEGIAC POETRY. 4 HOURS. Reading and analysis of the chief elegiac poems. Prerequisite: 4 hours of Latin at the 200 level or the equivalent.

360.   HORACE: *ODES* II AND *EPODES*. 4 HOURS. More extensive study of the *Odes*, with the addition of the *Epodes*. Prerequisite: One 200-level course in Latin.

361.   HORACE: *EPISTLES*. 4 HOURS. Reading and interpretation of the *Epistles*. Prerequisite: 8 hours of Latin at the 200 level or the equivalent.

362.   JUVENAL: *SATURAE*. 4 HOURS. Selections from the sixteen extant satires. Prerequisite: 8 hours of Latin at the 200 level or the equivalent.

370.   TACITUS: *ANNALS* AND *HISTORIES*. 4 HOURS. Intensive study of the early empire and the historiography of Tacitus; extensive reading in the works. Prerequisite: At least 8 hours of Latin at the 200 level or the equivalent.

381.   ROMAN LITERARY CRITICISM. 4 HOURS. The principal contributions of Latin writers to the study of literature. Prerequisite: At least 12 hours of Latin at the 200 level or the equivalent.

382.   ROMAN RHETORIC. 4 HOURS. Required of all Latin majors. The contributions of writers in Latin to the study and practice of rhetoric. Prerequisite: At least 12 hours of Latin or the equivalent.

384.   ROMAN SATIRE. 4 HOURS. Study of the definition, development, and problems of the genre through selections from the principal writers of satire. Prerequisite: 8 hours of Latin at the 200 level or the equivalent.

390.   THE TEACHING OF LATIN IN THE SECONDARY SCHOOL. 4 HOURS. Theory and practice in foreign language instruction as they apply specifically to teaching Latin at the secondary level; objectives of instruction in Latin, historical

perspectives, texts, and materials of instruction; preprofessional orientation. Prerequisite: At least 8 hours of Latin at the 300 level or approval of the department.

LATIN AMERICAN STUDIES

Courses for Graduate and Advanced Undergraduate Students

308. SPANISH-AMERICAN LITERATURE TO 1888 I. 4 HOURS. Same as Spanish 308. Development from the sixteenth century through the end of the Romantic period. Prerequisite: LASt. 223 or 224 or the equivalent.

309. SPANISH-AMERICAN LITERATURE TO 1888 II. 4 HOURS. Same as Spanish 309. Continues Latin American Studies 308. Prerequisite: LASt. 223 or 224.

310. *MODERNISMO* AND CONTEMPORARY SPANISH-AMERICAN POETRY I. 4 HOURS. Same as Spanish 310. Spanish-American poetry from 1888 to the present with some *Modernista* prose. Prerequisite: LASt. 223 or 224.

311. *MODERNISMO* AND CONTEMPORARY SPANISH-AMERICAN POETRY II. 4 HOURS. Same as Spanish 311. Continues Latin American Studies 310. Prerequisite: LASt. 223 or 224.

315. ADVANCED TOPICS IN BRAZILIAN LITERATURE. 4 HOURS. May be repeated for credit. Same as Portuguese 315. Topics related to various aspects of Brazilian literary history and Brazilian writers. Topics vary from quarter to quarter. Prerequisite: Port. 215.

323. THE CONTEMPORARY SPANISH-AMERICAN NOVEL I. 4 HOURS. Same as Spanish 323. From the Romantic period to 1930. Prerequisite: LASt. 223 or 224 or the equivalent.

324. THE CONTEMPORARY SPANISH-AMERICAN NOVEL II. 4 HOURS. Same as Spanish 324. Continues Latin American Studies 323. From 1930 to the present. Prerequisite: LASt 223 or 224.

334. ECONOMIC DEVELOPMENT. 4 HOURS. Same as Economics 334. Basic problems and characteristics of underdeveloped countries; classical, neoclassical, and modern contributions to the theory of development; major proposals for accelerating development; basic approaches to economic development; laissez-faire, interventionism; role and methods of planning; foreign aid; and economic integration. Prerequisite: Econ. 320 or 321.

354. PROBLEMS IN MESOAMERICAN ETHNOLOGY. 4 HOURS. Same as Anthropology 361. Intensive investigation of selected problems from the Mesoamerican area; special emphasis on religion, economics, and social organization. Prerequisite: LASt. 254.

361. TOPICS IN LATIN AMERICAN HISTORY. 4 HOURS. May be repeated for credit. Same as History 361. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

367.   PROBLEMS IN SOUTH AMERICAN ETHNOLOGY. 4 HOURS. Same as
       Anthropology 367. Intensive reading and research in theoretical and ethnographic
       problems in South American Indian social structures and cultures. Special
       attention is given to the influence of Levi-Strauss' ideas on the formulation of
       cultural theory in South America. Prerequisite: Graduate standing or Anth. 213
       and LASt. 255.

381.   SEMINAR: POLITICAL PROBLEMS OF DEVELOPING SOCIETIES. 4 HOURS.
       Same as Political Science 381. Selected aspects of the politics of the countries of
       Asia, Africa, and Latin America. Prerequisite: LASt. 280.

390.   TOPICS IN LUSO-BRAZILIAN LITERATURE. 4 HOURS. May be repeated for
       credit. Same as Portuguese 390. Topics related to various aspects of the
       Luso-Brazilian language, literature, and culture. Topics vary from quarter to
       quarter. Prerequisite: Consent of the instructor.

LITHUANIAN

Courses for Graduate and Advanced Undergraduate Students

331.   HISTORY OF THE LITHUANIAN LANGUAGE. 4 HOURS. Development of
       Lithuanian from its Indo-European origins to the formation of the standard
       language; the conservative aspects of Lithuanian and its relation to Slavic.
       Prerequisite: 24 hours of Lithuanian or the equivalent or Ling. 305.

332.   STRUCTURE OF LITHUANIAN. 4 HOURS. Synchronic analysis of the structure
       of standard Lithuanian; reference to its historical development. Prerequisite: 24
       hours of Lithuanian or the equivalent or Ling. 305.

MANAGEMENT

Courses for Graduate and Advanced Undergraduate Students

330.   ORGANIZATIONAL PSYCHOLOGY. 4 HOURS. Same as Psychology 330.
       Individual psychological and group processes and their interaction with
       organizational structure. Behavioral factors in effective organizational change.
       Prerequisites: Graduate standing or Psch. 230 and one course in social psychology
       or the equivalents.

333.   MOTIVATION AND MORALE IN INDUSTRY. 4 HOURS. Same as Psychology
       333. Concepts and methods in the assessment and modification of employee
       motivation, attitudes, and morale. Prerequisite: Graduate standing or 12 hours of
       psychology, including Psch. 332 or the equivalent.

335.   PSYCHOLOGY OF INDUSTRIAL TRAINING. 4 HOURS. Same as Psychology
       335. Psychological measurement techniques in assessing training needs and
       evaluating training effectiveness. Application of psychological techniques to the

development of industrial training programs. Prerequisite: Graduate standing or Psch. 332 or the equivalent.

338.   PSYCHOLOGY OF INDUSTRIAL CONFLICT. 4 HOURS. Same as Psychology 338. Behavioral analysis of the causes, dimensions, and modes of resolution of industrial conflict; special emphasis on labor-management relations. Prerequisite: Graduate standing or Psch. 330 or the equivalent.

350.   ORGANIZATION AND ADMINISTRATION. 4 HOURS. Theories of management; concepts of organization; major functions of management; fundamentals of decision making. Emphasis on the role of management and administration within the business firm. Prerequisite: QM 270.

351.   ORGANIZATION THEORY. 4 HOURS. Important theories of organization; their foundation, application, and consequences in the attainment of individual and organization objectives. Emphasis on formal and informal aspects of organizations, authority relationships, and structural aspects. Prerequisite: Mgmt. 350.

352.   ADMINISTRATION PRACTICES. 4 HOURS. Examination of executive and manager behavior in working organizations. Analysis of human problems and relationships at work. Leadership styles, problems of motivation and attitudes. Emphasis on behavioral science theory and technology as applied to business. Case method of analysis and study. Prerequisite: Mgmt. 351.

353.   PERSONNEL MANAGEMENT. 4 HOURS. The foundation, history, and objectives of manpower management; motivation and supervision; selection, training, and discipline; union-management relations; wage-and-salary administration; personnel research. Prerequisite: Mgmt. 350.

354.   INDUSTRIAL RELATIONS SYSTEMS. 4 HOURS. Analysis of labor unions and their impact on business firms and society. Types of labor-management relationships and collective bargaining practices. Examination of public policy, union structure, and bargaining theory. Prerequisite: Mgmt. 353 or the equivalent.

355.   OPERATIONS AND SYSTEMS MANAGEMENT I. 4 HOURS. Application of management sciences to the planning and design of operational systems. Emphasis on strategic planning, selection of objectives, forecasting of and response to changing technology and system controls. Prerequisite: QM 270 or the equivalent.

356.   OPERATIONS AND SYSTEMS MANAGEMENT II. 4 HOURS. Application of managerial sciences to operations and control of operational systems. Emphasis on systems operations facilities, systems standards and information flow, system maintenance, and the behavioral interface and system control. Prerequisite: Mgmt. 355 or the equivalent.

357.   OPERATIONS AND SYSTEMS MANAGEMENT III. 4 HOURS. Emerging concepts in management science. Managerial applications of computer technology and utilization and related electronic data processing. Applications of quantitative methods to information and control methods and systems. Process and systems design. Prerequisite: Mgmt. 356.

358. MANAGERIAL LOGISTICS. 4 HOURS. The management of all activities governing the physical flow of raw materials and finished goods through stages of production on to points of final consumption. Key areas considered include design of logistics systems, location theory, inventory control, and the use of mathematical techniques in solving problems of logistics management. A logistics system computer simulation game is used. Prerequisites: Mgmt. 351 and Econ. 321.

359. BUSINESS POLICY. 4 HOURS. The formulation and implementation of policies that determine the long-term character and performance of business firms. Problems in policy are analyzed from the vantage point of top management rather than from the limited view of a functional specialist. Through written analysis, classroom discussion of cases, and experience in management simulation the students are exposed to a wide variety of top management problems. The topics and cases covered are also appropriate for students interested in the management of public institutions. Prerequisite: Completion of core requirements of the College of Business Administration.

360. BUSINESS, SOCIETY, AND TECHNOLOGY. 4 HOURS. Business and the corporate role in a complex, technological society. Emphasis on the historical evolution of business; the many relationships of the corporation to its external environment; urban problems of business; the impact of the corporation on individual and group behavior. Prerequisites: Senior standing; Econ. 322 or 323; Mgmt. 351.

363. COLLECTIVE BARGAINING. 4 HOURS. Intensive examination of the structure and conduct of collective bargaining: the determination of the bargaining unit and bargaining representative; the negotiation and scope of contracts; the administration of contracts; the major substantive issues in negotiations; the procedures for resolving industrial conflict. Prerequisites: Mgmt. 353 and 354.

364. LABOR LAW AND NATIONAL LABOR POLICY. 4 HOURS. The evolution of national labor policy considered within a framework of labor legislation, court decisions, and administrative rules. Problems of effectuating labor agreements; problems of protecting individual employee rights in a collective bargaining context. Introduction to the legal and constitutional problems of government regulation of industrial and labor relations. Prerequisite: Mgmt. 354.

366. TECHNOLOGICAL FORECASTING. 4 HOURS. The methodology of forecasting the impact of technological change on the managerial process; emphasis on selection of goals and parameters, relevance of figures of merit and various forecasting methodologies. Prerequisite: Mgmt. 355 or the equivalent.

367. IMPACT OF TECHNOLOGICAL CHANGE. 4 HOURS. The impact of technological change on the business environment and the managerial process; emphasis on alternative futures and planning to attain desired ends. Prerequisite: Mgmt. 366.

373. COLLECTIVE BARGAINING IN PUBLIC EMPLOYMENT. 4 HOURS. Practices and legislation pertaining to union-management relations at the federal, state, and

local levels of government. Procedural and policy issues confronting public employees, union officials, and government administrators. Prerequisite: Junior standing.

374.   COMPARATIVE INDUSTRIAL RELATIONS SYSTEMS. 4 HOURS. Analysis of industrial relations structures, problems, and experiences among selected countries. Common and contrasting features of industrial relations systems are related to national economic, political, and social characteristics. Examination of the implication for management and economic development of differences among industrial relations systems. Prerequisites: Mgmt. 354.

399.   INDEPENDENT STUDY. 2 TO 4 HOURS. May be repeated once for credit. Students in the College of Business Administration may register for this course to pursue advanced independent study in approved topic(s) related to management. A written report prepared under the guidance of a major professor is required. Prerequisites: 16 hours of upper-division management courses and consent of the department head.

Courses for Graduate Students

451.   ORGANIZATION THEORY. 3 TO 4 HOURS. Classical and modern theories of organization. Organization structure and processes, line and staff relationships, management controls, managerial decision making, organizational objectives and restraints, management functions, formal and informal organization, bureaucracy, and behavioral science concepts. Prerequisite: Mgmt. 350.

452.   ADMINISTRATIVE PRACTICES. 3 TO 4 HOURS. Analysis of human problems in management and organization. Dynamics of leadership in the working organization, group dynamics, administrative behavioral patterns, administrative implications of decision making and policy formulation, and other relevant behavioral science concepts. Prerequisite: Mgmt. 451.

453.   PERSONNEL MANAGEMENT. 4 HOURS. Manpower management programs and policies. Staffing, training and development, historical evolution of personnel policies, modern labor force and technological trends, supervision, wage and salary administration, and manpower research and utilization. Prerequisites: Mgmt. 350 or the equivalent, and 451.

455.   OPERATIONS AND SYSTEMS MANAGEMENT. 4 HOURS. Basic principles and procedures for effective utilization of productive factors in a working organization. Facilities design, control systems, data processing, scheduling, automation, statistical analysis, computer technology, production planning, process design, and other relevant management science concepts. Prerequisites: QM 470 and 471.

457.   SEMINAR ON INTERNATIONAL BUSINESS. 4 HOURS. Management practices and problems in major nations. Legal and cultural factors affecting managerial policies and decisions; organization planning and manpower utilization, comparative management systems and ideologies. Prerequisite: Mgmt. 451.

458. SEMINAR ON BUSINESS POLICY AND DECISION THEORY. 4 HOURS. To be taken in the final quarter of the student's degree program. A capstone course to integrate all the functional areas of business: policy formulation and administration, policy and decision implementation, long-range planning, control techniques, factor analysis and decision making, theories of decision making in an uncertain environment, quantitative techniques, simulation and case exercises, and study of actual business firms.

459. BUSINESS AND SOCIETY. 4 HOURS. Historical background of American business systems and institutions; conflicts between business and economic groups; problems of social groups seeking specified goals in a pluralistic society. Prerequisite: Mgmt. 350.

MARKETING

Courses for Graduate and Advanced Undergraduate Students

360. PRINCIPLES OF MARKETING. 4 HOURS. Required of all students in the College of Business Administration. The workings of the marketing system and the way in which marketing decisions are made.

361. CONSUMER MARKET BEHAVIOR. 4 HOURS. Motivations underlying market behavior of consumers, producers, middlemen; drives, emotions, desires, learning, memory; effects of demographic characteristics, social status, and reference groups on marketing action. Prerequisite: Mktg. 360.

362. MARKETING RESEARCH AND INFORMATION SYSTEMS. 4 HOURS. Investigation of the gathering and interpretation of information used in solving marketing problems; pertinent modern research techniques from mathematics and the behavioral sciences are employed in developing an analytical structure. Prerequisites: Mktg. 361 and QM 272 or the equivalents.

363. MARKETING ORGANIZATION. 4 HOURS. Principles underlying the development of an integrated distribution system; its relationship to the marketing structure of the firm; evaluation of decisions on raw-material sources, plant and warehouse location, wholesale and retail outlets; analysis of the movement of products through marketing channels. Prerequisite: Mktg. 360.

364. MANAGING MARKETING COMMUNICATIONS. 4 HOURS. Analysis of communication information among producers, middlemen, and consumers for marketing purposes; managerial problems in directing a firm's promotional efforts; personal selling, advertising, sales promotion, public relations. Prerequisite: Mktg. 360.

365. MARKETING MANAGEMENT. 4 HOURS. Seminar. Building marketing programs to implement the achievement of marketing objectives. Individual and group research and presentation from the viewpoint of major marketing executives of the firm; business case analysis. Prerequisite: 20 hours of marketing.

366. COMPARATIVE MARKETING SYSTEMS. 4 HOURS. An advanced course that treats domestic marketing systems and their structures and processes in a framework of comparative cultural, political, economic, and social systems. Prerequisite: Mktg. 360.

367. MANAGEMENT SCIENCE IN MARKETING. 4 HOURS. Introduction to management science concepts and techniques used in the analysis and solution of marketing management problems in areas of advertising, pricing, product planning, personal selling, and distribution through the study of actual applications. Prerequisites: Mktg. 360, QM 272.

368. PROBLEMS IN MARKETING RESEARCH AND INFORMATION SYSTEMS. 4 HOURS. An advanced course. Pertinent marketing research and informational problems and techniques are used to solve an actual marketing problem. Prerequisite: Mktg. 362.

390. SPECIAL TOPICS IN MARKETING. 4 HOURS. Intensive study of selected problems. Reading assignments are drawn from scholarly and professional journals; emphasis on covering relatively few areas in great depth.

399. INDEPENDENT STUDY IN MARKETING. 1 TO 12 HOURS. May be taken for a total of 12 hours. Intensive study of one or more selected topics. Topic and research methodology is determined by consultation with the instructor. Prerequisites: Major in marketing and consent of the head of the department.

Courses for Graduate Students

400. PRINCIPLES OF MARKETING. 4 HOURS. Theory and practice in the formulation of marketing decisions; planning, pricing, and promotion; distribution of goods and services to all types of consumers.

460. MARKETING MANAGEMENT. 4 HOURS. The structural system for the management of marketing; environmental considerations; goal determination; the sequential process; marketing planning; product-market integration; channel components; demand stimulation; evaluation and audit. Prerequisite: Mktg. 400.

461. CONSUMER BEHAVIOR. 4 HOURS. Application of knowledge from the behavioral sciences to the study of consumer behavior. Individual, group, and cultural influences on consumer preferences and purchasing patterns. Emphasis on both theory and application; examination of the advantages and limitations of this approach to consumer behavior. Prerequisite: Mktg. 460.

463. INFORMATION FOR MARKETING DECISIONS. 4 HOURS. Problem definition and the selection of appropriate research techniques for the solution of specific marketing problems; design of the research project, administration of research, and special problems in marketing research. The establishment and administration of information systems to provide the firm with a systematic, continuing appraisal of its market position. Prerequisite: Mktg. 461.

465. MARKETING COMMUNICATION AND PROMOTIONAL STRATEGY. 4 HOURS. The ways in which a firm uses advertising, public relations, sales

promotion, and personal selling to communicate with its customers. The functional characteristics of each of these is assessed in terms of varying marketing situations in the process of formulating the firm's strategy. Prerequisite: Mktg. 463.

466. PERSPECTIVES IN CONSUMERISM. 4 HOURS. Review of current developments in consumer protection. Events leading to the emergence of the consumer movement, its current status with respect to the right of consumers to be protected against ineffective or unsafe products, and the effectiveness of consumer protection measures. Prerequisite: Mktg. 400.

467. MARKETING PROBLEMS OF SMALL BUSINESS. 4 HOURS. The unique marketing management and operating problems of small business and its possibilities. Small businesses are viewed as institutions that are qualitatively different from large businesses and have potential for urban economic development. Prerequisite: Mktg. 460 or the equivalent.

468. MARKETING IN THE INNER CITY. 4 HOURS. An in-depth study of marketing problems in the inner city and proposed solutions to these problems. The inner city marketplace viewed as a system whose improvement requires interrelated actions by the various individuals and organizations who are or should be involved in it. Prerequisite: Mktg. 460 or the equivalent.

MUSIC

Courses for Graduate and Advanced Undergraduate Students

300. SIXTEENTH CENTURY COUNTERPOINT. 3 HOURS. Late Renaissance music. Analysis of representative scores and written assignments in sixteenth century contrapuntal style. Prerequisites: Mus. 203 and 206 or approval of the department.

301. EIGHTEENTH CENTURY COUNTERPOINT. 3 HOURS. Middle-to-late Baroque music. Analysis of representative scores and written assignments in eighteenth century contrapuntal style. Prerequisite: Mus. 300 or approval of the department.

302. FORM AND ANALYSIS. 3 HOURS. The melodic, rhythmic, harmonic, and structural analytic procedures of traditional musical form. Analysis of representative scores from the eighteenth to the twentieth centuries. Prerequisite: Mus. 301.

303. COMPOSITIONAL TECHNIQUES OF THE TWENTIETH CENTURY. 4 HOURS. European and American twentieth century music. Analysis of representative scores and written assignments in composition in one or more of the several contemporary idioms. Prerequisite: Mus. 302.

320. PROSEMINAR ON MUSIC. 2 TO 4 HOURS. May be repeated for credit for a maximum of 12 hours. Selected topics for intensive study in specialized areas of musicology or music theory. Prerequisite: Senior standing as a music major.

330. MUSIC AS EXPERIENCE. 4 HOURS. The musical experience as found in the writings of theorists, composers, musicians, historians, critics, and philosophers. Prerequisites: Junior standing, Mus. 130, and one 200-level course in music.

PHYSICAL EDUCATION

Courses for Graduate and Advanced Undergraduate Students

300. ADMINISTRATIVE THEORY AND PRACTICE IN PHYSICAL EDUCATION. 4 HOURS. A theoretical approach to the development of administrative thought as it relates to physical education; emphasis on the understanding of concepts and models from the social sciences and their implications for leadership in the educational setting; development of a personal philosophy of administration. Prerequisite: PE 279.

301. EVALUATION IN PHYSICAL EDUCATION. 4 HOURS. The availability and value of evaluative tools in physical education; methods for administration of evaluative techniques; analysis of interpretation and use of the results from evaluative techniques; description of the construction of new evaluative instruments employed in physical education. Prerequisite: PE 251.

302. SYNTHESIS OF HUMAN MOVEMENT CONCEPTS. 4 HOURS. Integration of selected concepts from biomechanics, exercise physiology, psychology, and sociology as they apply to the development of meaningful human movement. Prerequisites: Senior standing and consent of the instructor.

303. INSTRUCTIONAL TECHNIQUES IN PHYSICAL EDUCATION. 4 HOURS. Theory and practice; special emphasis on the application of motor learning research to instructional techniques and teaching styles. Prerequisites: Senior standing and consent of the instructor.

305. SPECIAL PROJECTS IN PHYSICAL EDUCATION. 2 TO 4 HOURS. Independent research on special projects. Prerequisite: Approval of the student's project by a graduate faculty member.

306. THE SPORT AND PLAY OF AMERICA. 4 HOURS. The creation, importation, and derivation of sport and play in America; course of development and adaptation to the nature of American life; impact of the political, economic, cultural, and geographical factors on the character of sport and play. Special emphasis on sport and play in urban America. Prerequisite: PE 252.

308. ADAPTED PHYSICAL EDUCATION PROGRAMS. 4 HOURS. Organization and administration; content selection, screening techniques, and instructional design with application of kinesiological, sociological, and psychological principles to the needs of atypical students. Prerequisite: PE 253.

313. CURRICULUM CONSTRUCTION IN PHYSICAL EDUCATION. 4 HOURS. Principles of curriculum development and evaluation for physical education; analysis of age characteristics, needs, interests, and goals of students in a variety

of community settings and their implications for the curriculum; development of psychomotor behavioral objectives for curricular offerings for various learning groups. Prerequisite: Ed. 230.

370. PHILOSOPHY OF PHYSICAL EDUCATION. 4 HOURS. Historical development of the philosophies of physical education and the assumptions on which current professional philosophies rest. Theory of knowledge in physical education.

Courses for Graduate Students

405. SUPERVISION OF THE PHYSICAL EDUCATION PROGRAM. 4 HOURS. Theory, practices, and processes for effective supervision of the teaching-learning environment in physical education. Prerequisite: PE 278.

431. LEISURE IN THE URBAN COMMUNITY. 4 HOURS. Readings and research in leisure concepts, the urban environment, and the interrelationship for urban leisure service. Prerequisite: Knowledge of research techniques.

POLISH

Courses for Graduate and Advanced Undergraduate Students

301. ADVANCED POLISH CONVERSATION AND COMPOSITION I. 4 HOURS. Development of oral and writing skills: expanding vocabulary, developing style. Aural comprehension practice. Prerequisite: Pol. 203 or the equivalent.

302. ADVANCED POLISH CONVERSATION AND COMPOSITION II. 4 HOURS. Continues Polish 301. Prerequisite: Pol. 301 or the equivalent.

303. ADVANCED POLISH CONVERSATION AND COMPOSITION III. 4 HOURS. Continues Polish 302. Prerequisite: Pol. 302 or the equivalent.

340. POLISH ROMANTICISM. 4 HOURS. Polish-Russian literary relationship during the Romantic period, major works of Mickiewicz, Slowacki, Krasinski, and Norwid. Prerequisite: Junior standing.

341. THE POLISH NOVEL. 4 HOURS. Major works from the eighteenth century to the present. Emphasis on Krasicki, Kraszewski, Sienkiewicz, Prus, Orzeszkowa, Zeromski, Nalkowska, Dabrowska. Prerequisite: Junior standing.

342. POLISH DRAMA. 4 HOURS. Major plays of Fredo, Mickiewicz, Slovacki, Krasinski, Wyspianski, Witkiewicz, Gombrowicz, and Mrozek. Prerequisite: Junior standing.

399. INDEPENDENT STUDY. 1 TO 4 HOURS. Investigation of special problems under the general direction of a staff member. Prerequisite: Consent of the instructor and the head of the department.

PORTUGUESE

Courses for Graduate and Advanced Undergraduate Students

314. ADVANCED TOPICS IN BRAZILIAN LITERATURE. 4 HOURS. May be repeated for credit. Same as Latin American Studies 315. Topics related to various aspects of Brazilian literary history and Brazilian writers. Topics vary from quarter to quarter. Prerequisite: Port. 215.

390. TOPICS IN LUSO-BRAZILIAN LITERATURE. 4 HOURS. May be repeated for credit. Same as Latin American Studies 390. Topics related to various aspects of Luso-Brazilian language, literature, and culture. Topics vary from quarter to quarter. Prerequisite: Consent of the instructor.

399. INDEPENDENT STUDY. 1 TO 6 HOURS. May be repeated for credit. For graduate students who wish to independently research various aspects of Luso-Brazilian studies. Prerequisite: Consent of the instructor.

QUANTITATIVE METHODS

Courses for Graduate and Advanced Undergraduate Students

369. MULTIVARIATE ANALYSIS I. 4 HOURS. Introduction to the structure of multivariate data and its analysis using the multivariate normal model. The relevant matrix theory; multilinear regression; tests concerning multivariate means; multivariate analysis of variance. Prerequisite: QM 272.

370. MULTIVARIATE ANALYSIS II. 4 HOURS. Multivariate techniques of data analysis in common use. Topics include principal components, factor analysis, canonical correlation, discriminant analysis classification procedures.

371. SURVEY RESEARCH. 4 HOURS. Application of sampling theory and methods to planning, conducting, and evaluating surveys for measuring public opinion, consumer attitudes and preferences. Instruments of measurement, sample design estimation, sources of errors and bias. Case studies with application to actual situations. Prerequisite: QM 272 or the equivalent.

373. ANALYSIS OF VARIANCE AND EXPERIMENTAL DESIGN. 4 HOURS. General theory of design and analysis of experiments. Least squares estimation, multiple regression, analysis of variance, randomization, randomized blocks, Latin squares, factorial designs, replication, incomplete blocks. Prerequisite: QM 272.

375. INFORMATION SYSTEMS. 4 HOURS. An introduction to the theory and concepts of systems, including classification, deterministic and probabilistic models, Markov processes and Monte Carlo techniques, simulation. Introduction to the models as related to the computer; types of programming; experimentation and evaluation. Prerequisite: QM 272. Mathematics 194 or 195 is recommended.

376. SURVEY OF OPERATIONS RESEARCH. 4 HOURS. Methods, techniques, and applications; linear programming, simulation, production and inventory theory, queueing theory, game theory. Prerequisites: QM 272 and Math. 112.

378. DYNAMIC PROGRAMMING. 4 HOURS. Theory and application to solving problems in multistage decision processes arising in a wide variety of fields, such as operations research, engineering, and mathematics. Deterministic and random processes are considered, and computational and analytical methods of solution derived. Prerequisites: Math. 133 and 220 or the equivalents.

399. INDEPENDENT STUDY IN QUANTITATIVE METHODS. 1 TO 4 HOURS. May be repeated for a total of 12 hours. Intensive study of selected topics to be determined in consultation with the instructor and department head. Prerequisites: Major in quantitative methods and consent of the department head.

Courses for Graduate Students

470. MATHEMATICAL METHODS I. 4 HOURS. Designed primarily to introduce and/or review areas of mathematics necessary for the development and understanding of the analytic tools students will encounter in subsequent courses of a Master in Business Administration program. Elementary set theory; mathematical functions; introduction to probability concepts; differential and integral calculus; series; functions of several variables. Prerequisites: Math. 110, 111, 112; QM 270, 271, and 272.

471. MATHEMATICAL METHODS II. 4 HOURS. Sets and set functions; vector and matrix algebra; introduction to linear programming and game theory. At least one hour per week of laboratory in the use and application of digital computers and development in computer technology applicable to modern business operations. Prerequisites: Math. 110, 111, 112; QM 270, 271, and 272.

472. STATISTICS, THEORY AND APPLICATIONS. 4 HOURS. Statistics and scientific method; uncertainty and probability, including Bayesian theory; binomial normal, t, Chi square, and F distributions; testing hypotheses and estimation; decision theory; analysis of variance, including regression and correlation; time series. Prerequisites: Math. 110, 111, 112; QM 270, 271, and 272..

474. STATISTICAL DECISION THEORY. 4 HOURS. Hypothesis testing from the classical and Bayesian viewpoints with applications of probability to the making of decisions; some treatment of game strategy and its parallels in decision making. Prerequisite: QM 472.

475. BUSINESS RESEARCH AND FORECASTING. 4 HOURS. The role of research in business, forecasting methods and techniques, including models and their applications. Prerequisite: QM 472.

RELIGIOUS STUDIES

Courses for Graduate and Advanced Undergraduate Students

300. MYTHOLOGY IN ROME. 4 HOURS. Same as Classics 348. The conscious

assimilation and adaptation of Greek myth in Rome; investigation of the concept of myth. Prerequisite: Cl. 248.

304.   SEVENTEENTH CENTURY RATIONALISM. 4 HOURS. Same as Philosophy 304. Selected readings and discussion from the works of Descartes, Spinoza, Leibniz, and others. Prerequisite: Phil. 298.

306.   TOPICS IN MEDIEVAL HISTORY. 4 HOURS. May be repeated for credit. Same as History 306. Special topics are announced each quarter. Prerequisite: 4 hours of medieval history.

312.   GEOGRAPHY OF RELIGIONS. 4 HOURS. Same as Geography 312. Systematic treatment of geographical manifestations of the major religious systems of the world. Special attention to the geographical origins and dispersal mechanisms of religious systems and to the manner in which man organizes his life within the framework of his belief. Intensive study of applications being made in the geographical inquiry of religious systems. Prerequisites: Geog. 190 and 210.

313.   THE CLAIMS OF SCIENCE AND RELIGION. 4 HOURS. Same as Philosophy 313. Convergence and conflict between the results of science and the claims of religion; similarities and differences between their methods of inquiry. Prerequisites: RelS. 214 and one course in philosophy.

315.   COMPARATIVE RELIGIOUS MOVEMENTS. 4 HOURS. Same as Anthropology 315. Analysis of religious behavior; special reference to the emergence of messianic cults in Africa and Melanesia and among North American Indians and New World Negroes. Prerequisites: Junior standing, 8 hours of social anthropology or 8 hours of sociology, and consent of the instructor.

332.   ETHICS AND VALUE THEORY. 4 HOURS. Same as Philosophy 332. The nature of moral judgments and moral reasoning; ethics as a normative discipline; definitions of "value"; ethical judgments as a kind of value judgment. Prerequisite: Two courses in philosophy, one of which must be a 200-level course.

348.   ST. AUGUSTINE: *THE CONFESSIONS*. 4 HOURS. Same as Latin 348. The autobiographical portions of *The Confessions*. Prerequisite: One 200-level course in Latin.

365.   ARISTOTLE: *NICOMACHEAN ETHICS*. 4 HOURS. Same as Greek 365. Reading and analysis of selections from several books. Sources and problems of Aristotle's ethical writings. Prerequisite: 8 hours of classical Greek at the 200 level or the equivalent.

395.   TOPICS IN RELIGIOUS HISTORY. 4 HOURS. May be repeated for credit. Same as History 395. Specific topics are announced each quarter. Prerequisite: 4 hours of history.

398.   THE PROBLEM OF JUSTICE. 4 HOURS. Same as Criminal Justice 398 and Political Science 398. The premodern understanding of justice, Plato's or Aristotle's; the modern understanding of justice, such as Hobbes' or Locke's,

which is the foundation of the modern political regime; Rousseau's seminal political thought on justice, which is the basis of a variety of reforms and alternatives offered to Hobbes' and/or Locke's political regime. Prerequisite: Two courses in political science, including PolS. 150 or 151.

RUSSIAN

Courses for Graduate and Advanced Undergraduate Students

301. ADVANCED RUSSIAN CONVERSATION AND COMPOSITION I. 4 HOURS. The development of oral and writing skills: vocabulary building, style development; aural comprehension practice. Prerequisite: Russ. 203 or the equivalent.

302. ADVANCED RUSSIAN CONVERSATION AND COMPOSITION II. 4 HOURS. Continues Russian 301. Prerequisite: Russ. 301 or the equivalent.

303. ADVANCED RUSSIAN CONVERSATION AND COMPOSITION III. 4 HOURS. Continues Russian 302. Prerequisite: Russ. 302 or the equivalent.

307. METHODOLOGICAL PROBLEMS IN RUSSIAN INSTRUCTION. 4 HOURS. Analysis and discussion of special methodological problems connected with the teaching of Russian. Prerequisite: Russ. 203 or the equivalent.

308. RUSSIAN APPLIED LINGUISTICS FOR TEACHERS. 4 HOURS. Classroom application of linguistic principles and techniques. Prerequisite: Russ. 203 or the equivalent.

320. RUSSIAN POETRY I. 4 HOURS. Major poets from 1700 to 1840: Lomonosov, Derzhavin, Krylov, Pushkin, and others. Prerequisite: 24 hours of Russian.

321. RUSSIAN POETRY II. 4 HOURS. Major poets from 1840 to the 1890's: Zhukovsky, Batyushkov, Lermontov, Nekrasov, Tyutchev, Fet, and others. Prerequisite: 24 hours of Russian.

322. RUSSIAN POETRY III. 4 HOURS. Major poets from the 1890's to the present: Bely, Blok, Akhmatova, Mandelshtam, Yesenin, Mayakovsky, Pasternak, Yevtushenko, Voznesensky, and others. Prerequisite: 24 hours of Russian.

324. STUDIES IN RUSSIAN LITERARY CRITICISM. 4 HOURS. Belinsky, Chernyshevsky, Herzen, Dobrolyubov, Pisarev, L.N. Tolstoy. Prerequisite: Slav. 224.

332. PROBLEMS IN RUSSIAN GRAMMAR. 4 HOURS. May be repeated once for credit. Required for Russian teaching majors. Intensive study and review of problems of Russian grammar and syntax. Prerequisite: Russ. 201.

350. RUSSIAN NOVEL I. 4 HOURS. Historical and critical study of the development of the Russian novel from 1800 to about 1860: Pushkin, Lermontov, Gogol, Goncharov, Chernyshevsky. Prerequisite: Junior standing.

351. RUSSIAN NOVEL II. 4 HOURS. Continues Russian 350. Development from 1860 to about 1900: Turgenev, Saltykov-Shchedrin, L.N. Tolstoy, Dostoevsky. Prerequisite: Junior standing.

352. RUSSIAN NOVEL III. 4 HOURS. Continues Russian 351. Development from 1900 to the present: Gorky, Zamyatin, Sholokhov, A.N. Tolstoy, Ehrenburg, Pasternak, Bulgakov, Solzhenitsyn. Prerequisite: Junior standing.

360. SURVEY OF RUSSIAN DRAMA. 4 HOURS. Major authors from the beginning of the Enlightenment to the end of the nineteenth century: Fonvizin, Griboedov, Pushkin, Gogol, Turgenev, Ostrovsky, L.N. Tolstoy, Chekhov, Gorky. Prerequisite: Slav. 224 or Spch. 122.

361. TWENTIETH CENTURY RUSSIAN DRAMA. 4 HOURS. Major authors: Gorky, Andreev, Bulgakov, Mayakovsky, and others. Prerequisite: Slav. 224 or Spch. 122.

399. INDEPENDENT STUDY. 1 TO 4 HOURS. Investigation of special problems under the general direction of a staff member. Prerequisite: Consent of the instructor and the head of the department.

SLAVIC LANGUAGES AND LITERATURES

Courses for Graduate and Advanced Undergraduate Students

310. INTRODUCTION TO SLAVIC LINGUISTICS. 4 HOURS. Survey of fundamental linguistic concepts and investigation of theoretical methods most applicable to analysis of the Slavic languages. Prerequisites: Graduate standing and two years of Russian or some other Slavic language; advanced undergraduate students with exceptional ability may be admitted with the consent of the instructor.

399. INDEPENDENT STUDY. 1 TO 4 HOURS. Investigation of special problems under the general direction of a staff member. Prerequisite: Consent of the instructor and of the head of the department.

SYSTEMS ENGINEERING

Courses for Graduate and Advanced Undergraduate Students

307. CYBERNETICS I. 4 HOURS. Same as Information Engineering 307. Introduction to artificial intelligence and pattern recognition by computer. Programs for playing games, proving theorems, answering questions, and making medical diagnoses. Property selection and decision-making techniques. Prerequisites: Math. 195 and either 250 or 370.

315. DYNAMIC SYSTEMS ANALYSIS I. 4 HOURS. Mathematical modeling of systems described by ordinary differential and difference equations with application to engineering and socio-technological systems. Matrix transfer function forms for interacting systems. The Laplace and Z Transform methods as

applied to specific problems. Solutions for elementary topologies using computer simulations as laboratory experiments. Prerequisites: InfE. 210, Math. 195.

316. DYNAMIC SYSTEMS ANALYSIS II. 4 HOURS. Computer and analytical modeling of inherently or topologically nonlinear socio-technological systems. Stability analysis. Systems with transport delays. One- and two-dimensional distributed models. Laboratory simulation of particular systems. Prerequisite: SysE. 315.

335. URBAN SYSTEMS I. 4 HOURS. Transportation in metropolitan areas, application of the systems approach to transportation, urban development forecast models, urban transportation forecast models, data collection procedures for determining urban travel behavior. Prerequisites: SysE. 342 or Soc. 201 and Math. 112; Econ. 321 or 120.

336. URBAN SYSTEMS II. 4 HOURS. Analysis of techniques used in urban systems engineering; emphasis on urban transportation systems and evaluation methodologies for selection of alternative urban system designs. Prerequisites: SysE. 335, 371, and QM 369.

337. URBAN TRANSPORTATION MODELS. 4 HOURS. Specific models used in urban transportation studies; structuring transportation model sets including data management needs and legal constraints. Prerequisites: SysE. 335, 371, and QM 369.

338. URBAN TRANSPORTATION SYSTEMS PLANNING. 4 HOURS. Evolution of transportation planning in the United States, major transportation planning studies and their methodologies, continuing planning studies, additional planning models. Term planning project. Laboratory. Prerequisites: SysE. 337 and QM 371.

341. MAN-MACHINE SYSTEMS. 4 HOURS. Specific system areas in which the role of man in the system operation requires a systematic analysis of the human component in the system. Examination of the critical concepts, variables, and techniques involved in optimum design of human operated systems. Laboratory experiments on man-machine interactions. Prerequisite: SysE. 315.

342. EXPERIMENTAL DESIGN. 4 HOURS. Fundamental concepts of statistical analysis. Introduction to standard experimental designs and their associated application in the statistical interpretation of research data and design of engineering systems. Completely random designs, randomized block designs, Latin squares, covariance analysis, and factorial experience. Prerequisites: Math. 195 and 220.

345. MODELING IN SOCIO-TECHNOLOGICAL SYSTEMS. 4 HOURS. Theory and practice; static and dynamic systems, continuous and discrete models, stochastic and deterministic modeling, principles of mega-systems. Simulation laboratory. Prerequisites: SysE. 225, 342.

350. STOCHASTIC PROCESSES. 4 HOURS. Description and analysis of probabilistic systems; recurrent event models, Markov processes, and queueing systems; digital

computer simulation of stochastic processes in socio-technological systems; applications to specific engineering systems. Prerequisite: SysE. 342.

365. INDUSTRIAL ENGINEERING METHODS. 4 HOURS. Structure and theory of industrial organization; sales forecasting; investment analysis; plant layout and materials handling; methods analysis; work measurement systems; wage incentives and labor relations; industrial planning and policy development. Prerequisite: SysE. 342.

366. INDUSTRIAL ENGINEERING CONTROLS. 4 HOURS. Microanalysis of industrial processes; quality control; inventory theory; production planning and control; man-machine scheduling models; assembly line balancing; reliability models. Prerequisite: SysE. 342.

367. INDUSTRIAL SYSTEMS SIMULATION. 4 HOURS. The solution of industrial problems by means of computer simulation. Simulation strategies. Planning and industrial simulation experiment. In-depth study of some simulation programming languages as they apply to industrial problems and general examination of their usefulness. Major industrial simulation project. Prerequisite: SysE. 342.

368. INDUSTRIAL SYSTEMS OPERATIONS. 4 HOURS. Industrial plant organization and labor administration. Industrial engineering as a staff function. Value engineering. Clerical systems analysis. Building automation systems. Industrial engineering in the service industries. Course project. Prerequisite: SysE. 367.

371. OPTIMIZATION TECHNIQUES I. 4 HOURS. Linear programming models, simplex method, sensitivity analysis, transportation problems, duality. Nonlinear programming models, separable objective function, geometric programming, Kuhn-Tucker equations, quadratic programming. Prerequisites: Math. 195 and 220.

372. OPTIMIZATION TECHNIQUES II. 4 HOURS. Dynamic programming. Optimal control theory; Bellman, Hamilton-Jacobi, and Euler-Lagrange equations; Pontryagin's maximum principle. Applications of optimization techniques to socio-technological models and engineering systems. Simulation laboratory using examples of actual systems. Prerequisites: Math. 195 and 220.

373. OPTIMIZATION TECHNIQUES III. 4 HOURS. Determination of optimum strategies to solve probabilistic engineering problems. Use of random experiments to improve engineering decisions. Solution of multistage decision problems. Game theory. Prerequisite: SysE. 342.

391. SEMINAR. 1 TO 4 HOURS. May be repeated. Topics to be arranged. Prerequisite: Consent of the instructor.

393. SPECIAL PROBLEMS. 2 TO 4 HOURS. Special problems or reading by arrangement with the faculty. Prerequisite: Consent of the instructor.

396.   SENIOR DESIGN I. 4 HOURS. Same as Energy Engineering 396, Information Engineering 396, and Materials Engineering 396. Introduction to engineering economics, legal and social constraints on design, safety and reliability theory, and the use of simulation and optimization techniques in the engineering design process. Prerequisite: Senior standing in the College of Engineering.

397.   SENIOR DESIGN II. 4 HOURS. Same as Energy Engineering 397, Information Engineering 397, and Materials Engineering 397. Application of principles of engineering and engineering design methodology to the solution of a large-scale design problem. May be taken in any department, regardless of area of concentration. Prerequisite: SysE. 396.

Courses for Graduate Students

411.   SYSTEMS THEORY I. 4 HOURS. Linear systems theory: state equations formulation, transform methods, structural properties, stability, observability, and controllability. Linear stochastic systems. Prerequisites: SysE. 316, 342.

412.   SYSTEMS THEORY II. 4 HOURS. General systems theory: observability, controllability, and stability for systems described by nonlinear, partial, and differential-difference equations. Prerequisite: SysE. 411.

413.   DIFFERENTIAL GAMES AND APPLICATIONS. 4 HOURS. Differential game theory as applied to mathematical models of socioeconomic and urban type systems. Optimal strategies are obtained as functions of the state variables, and computer simulations are used to determine optimal trajectories. Prerequisite: SysE. 372.

445.   ADVANCED MODELING IN SOCIO-TECHNOLOGICAL SYSTEMS. 4 HOURS. Detailed studies of strategies and tactics for analyzing and designing large-scale complex engineering systems. Student teams formulate and exercise analytic and predictive models of engineering systems and their interaction with their environments. Prerequisite: SysE. 345.

450.   APPLIED STOCHASTIC PROCESSES. 4 HOURS. The stochastic nature of queues, inventories, and engineering reliability. Comprehensive analysis of queueing systems, Markov chains, and inventory models; engineering analysis of reliability problems. Prerequisite: SysE. 350.

451.   DECISION THEORY. 4 HOURS. Introduction to the mathematical analysis of decision making when the state of the world is uncertain but further information about it can be obtained by experimentation. Formal consideration of the decision maker's knowledge about the application; utility theory. Relation between Bayesian and traditional statistical decision theory. Prerequisite: SysE. 350.

455.   URBAN INFORMATION SYSTEMS. 4 HOURS. The fundamental informational bases of urban system and subsystem structure, operations, and decision and control; cybernetic urban models, functional aspects of information systems, and

operational examples of formalized systems; design of specialized planning information systems, including the establishment and fulfillment of information requirements. Prerequisite: SysE. 337.

460. THEORY OF TRANSPORTATION NETWORKS. 4 HOURS. Establishment of a mathematical basis for network flows and the relation of this basis to combinatorial analysis and graph theory. Consideration of static and dynamic maximal flows, multi-terminal flows, and multi-commodity flows. Application of these techniques to such other problems as the trim problem, the warehousing problem, and the allocation-location problem. Prerequisites: SysE. 337, 371, and 372.

471. MATHEMATICAL PROGRAMMING IN INDUSTRIAL SYSTEMS. 4 HOURS. Consideration of mathematical programming as applied to functional areas of business and industry; review of status of operations research in major industries. Prerequisites: SysE. 371, 372.

472. STOCHASTIC OPTIMIZATION. 4 HOURS. Development of algorithms which optimize mathematical models involving random variables for coefficients and/or restrictions. Consideration of changes necessary in linear programming and dynamic programming methods that allow handling of stochastic problems. Effect of underlying stochastic processes on nature of solution. Prerequisites: SysE. 350, 373.

495. INDIVIDUAL RESEARCH. 2 TO 4 HOURS. May be repeated for a maximum of 12 hours. Research on special problems not included in graduate thesis. Prerequisite: Consent of the instructor.

498. SEMINAR ON SYSTEMS ENGINEERING. 2 TO 4 HOURS. May be repeated for a maximum of 12 hours. Systematic treatment of special topics; emphasis on current research. Prerequisite: Consent of the instructor.

499. GRADUATE THESIS. 0 TO 16 HOURS. May be repeated. Thesis work under the supervision of a graduate adviser. Prerequisite: Consent of the instructor.

ADDITIONAL FACULTY OF THE GRADUATE COLLEGE

The following faculty hold graduate standing and teach in departments that presently offer graduate-level courses but not graduate degrees.

Gyan C. Agarwal, Associate Professor of Systems Engineering
Rene Amon, Professor of Architecture
Jean H. Baer, Associate Professor of Education
Morris Barazani, Associate Professor of Art
Bernard H. Baum, Professor of Management and Sociology
Edmund Bender, Assistant Professor of French
Bertram Berenson, Professor of Architecture
Nancy D. Berryman, Professor of Art
Tanis Bryan, Assistant Professor of Education
George Bugliarello, Professor of Systems Engineering
Felix Candela, Professor of Architecture
Patricia S. Charlier, Associate Professor of Education
Priscilla P. Clark, Associate Professor of French
Edwin Cohen, Professor of Accounting
Edward Colker, Professor of Art
Peter V. Conroy, Assistant Professor of French
Leonard J. Currie, Professor of Architecture
Edward L. Deam, Professor of Architecture
James H. Dee, Assistant Professor of Classics
Rheta DeVries, Assistant Professor of Education
Matthew W. Dickie, Assistant Professor of Classics
Mary A. Divito, Assistant Professor of Physical Education for Women
Maurice Eash, Professor of Education
Donald L. Ehresmann, Associate Professor of History of Architecture and Art
Joseph Engel, Professor of Systems Engineering
Patricia L. Engle, Assistant Professor of Education
Dorinda Evans, Assistant Professor of History of Architecture and Art
Lawrence P. Feldman, Associate Professor of Marketing
Sheldon L. Fordham, Professor of Physical Education for Men
Wayne Fredrick, Assistant Professor of Education
Elizabeth Gebhard, Associate Professor of Classics
Michael Gelick, Associate Professor of Architecture
Charles B. Genther, Professor of Architecture
Dorothy F. Gillanders, Professor of Physical Education for Women
Dwora Gilula, Assistant Professor of Classics
Brian Gluss, Professor of Quantitative Methods
Yehuda Gur, Visiting Assistant Professor of Systems Engineering
Robert E. Hallowell, Professor of French
Irvin L. Heckmann, Professor of Management

Helen M. Heitmann, Professor of Physical Education for Women
Jacob Hornik, Assistant Professor of Marketing
S. George Huneryager, Professor of Management
Emanuel Hurwitz, Jr., Associate Professor of Education
Joseph Jachna, Associate Professor of Art
Jerald Jackard, Associate Professor of Art
Thomas Jaeger, Associate Professor of Architecture
William M. Kaplan, Associate Professor of Music
Leonard Kent, Professor of Quantitative Methods
Marian Kneer, Assistant Professor of Physical Education for Women
Howard F. Koeper, Professor of History of Architecture and Art
Carol LaBranche, Assistant Professor of History of Architecture and Art
Carl M. Larson, Professor of Marketing
Marie E. Lein, Professor of French
Edwin B. Levine, Professor of Classics
Thomas E. Linton, Professor of Education
Charles Lombard, Professor of French
Alfred Maurice, Professor of Art
John D. McNee, Professor of History of Architecture and Art
George Megarefs, Professor of Structural Engineering (Architecture)
Julius Menacker, Associate Professor of Education
Floyd G. Miller, Assistant Professor of Systems Engineering
Barbara G. Mittman, Assistant Professor of French
Edward Minieka, Associate Professor of Quantitative Methods
George Monroe, Associate Professor of Education
June Moravcevich, Assistant Professor of French
Nicholas Moravcevich, Professor of Slavic Languages and Literatures
Van Cleve Morris, Professor of Education
Keith Morrison, Associate Professor of Art
Helmer K. Myklebust, Professor of Education
Nancy L. Nihan, Associate Professor of Systems Engineering
Richard E. Norton, Associate Professor of Music
William O'Neill, Associate Professor of Systems Engineering
Lawrence B. Oscai, Associate Professor of Physical Education for Men
Kenneth I. Perry, Associate Professor of French
Wilma Pesavento, Associate Professor of Physical Education for Women
Daniel Powell, Associate Professor of Education
Elizabeth Pribic, Associate Professor of Russian and Slavic Languages
Robert Ratcliffe, Associate Professor of Education
Robert Rippey, Professor of Education
Lalitha Sanathanan, Assistant Professor of Quantitative Methods
Mary Schlinger, Associate Professor of Marketing
David M. Sokol, Associate Professor of History of Architecture and Art
Alvin Star, Associate Professor of Marketing
Franklin P. Sweetser, Associate Professor of French
Marie-Odile Sweetser, Associate Professor of French

Harriet Talmage, Associate Professor of Education
Gunther Tetz, Assistant Professor of Art
Dorothy R. Thelander, Associate Professor of French
Philip Tiemann, Associate Professor of Education
William W. Tongue, Professor of Economics and Finance
Judith V. Torney, Associate Professor of Education
Theodore J. Tracy, Associate Professor of Classics
Nicholas J. Valenziano, Assistant Professor of Music
Walter Wadycki, Assistant Professor of Quantitative Methods
Herbert Walberg, Professor of Education
Edward W. Walbridge, Assistant Professor of Systems Engineering
Donald Warren, Assistant Professor of Education
Victor B. Weber, Assistant Professor of Music
Robert E. Weigand, Professor of Marketing
Frederick P. Wiesinger, Professor of Structural Engineering (Architecture)
A. Richard Williams, Visiting Adjunct Professor of Architecture
Edward Wynne, Associate Professor of Education

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